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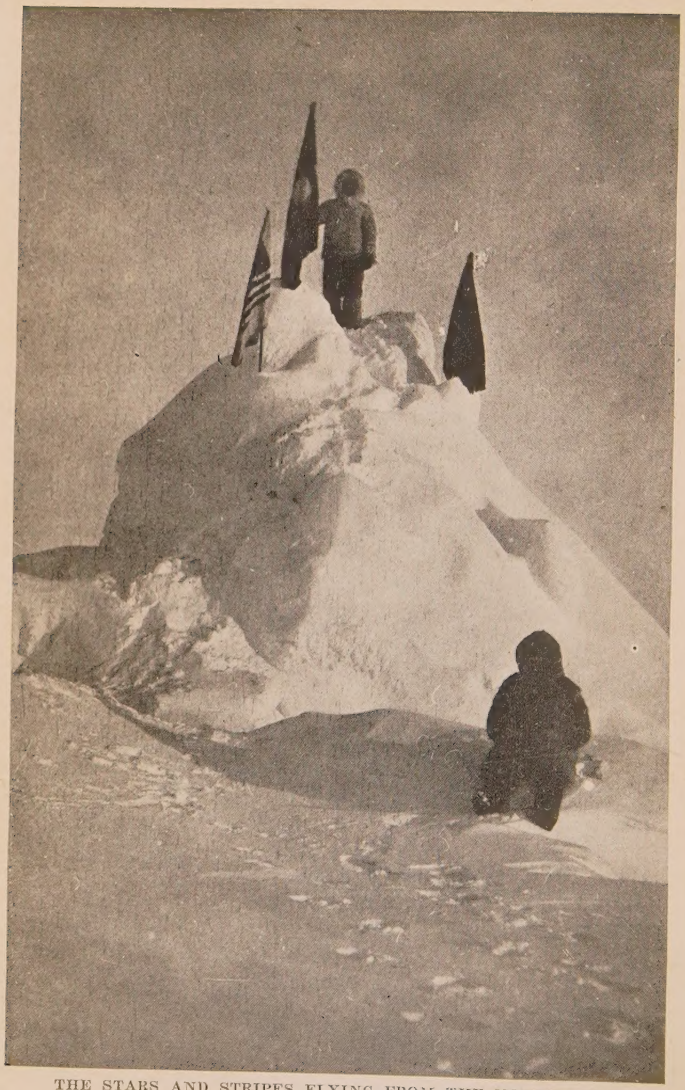

THE STARS AND STRIPES FLYING FROM THE NORTH POLE

SECRETS OF POLAR TRAVEL

BY

ROBERT E. PEARY

ILLUSTRATED WITH
PHOTOGRAPHS

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INTRODUCTION

In my book "The North Pole" appeared a brief résumé, or synopsis, of my system of arctic exploration, which was the evolution of years of continuous practical work and experience in extreme high latitudes, wherein everything that could be thought of in the way of perfecting arctic methods and equipment was worked out.

Ideas that in the mind or on paper appeared promising were tested relentlessly under the most hostile conditions. Those that failed under the test were abandoned, and those that gave evidence of containing some meat were perfected, until at last the entire subject of perfected equipment and methods, combined with the thorough knowledge of all conditions to be encountered gained through years of experience, compelled success. This was the résumé:

The so-called "Peary System" is too complex to be covered in a paragraph, and involves too many technical details to be outlined fully in any popular narrative. But the main points of it are about as follows:

To drive a ship through the ice to the farthest possible northern land base from which she can be driven back again the following year.

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To do enough hunting during the fall and winter to keep the party healthily supplied with fresh meat.

To have dogs enough to allow for the loss of sixty per cent of them by death or otherwise.

To have the confidence of a large number of Eskimos, earned by square dealing and generous gifts in the past, so that they will follow the leader to any point he may specify.

To have an intelligent and willing body of civilized assistants to lead the various divisions of Eskimos—men whose authority the Eskimos will accept when delegated by the leader.

To transport beforehand to the point where the expedition leaves the land for the sledge journey, sufficient food, fuel, clothing, stoves (oil or alcohol) and other mechanical equipment to get the main party to the Pole and back and the various divisions to their farthest north and back.

To have an ample supply of the best kind of sledges.

To have a sufficient number of divisions, or relay parties, each under the leadership of a competent assistant, to send back at appropriate and carefully calculated stages along the upward journey.

To have every item of equipment of the quality best suited to the purpose, thoroughly tested, and of the lightest possible weight.

To know, by long experience, the best way to cross wide leads of open water.

To return by the same route followed on the upward march, using the beaten trail and the already constructed igloos to save the time and strength that would have been expended in constructing new igloos and in trail-breaking.

To know exactly to what extent each man and dog may be worked without injury.

To know the physical and mental capabilities of every assistant and Eskimo.

Last, but not least, to have the absolute confidence of every member of the party, white, black, or brown, so that every order of the leader will be implicitly obeyed.

In "Secrets of Polar Travel" it is the intention to enlarge upon the above synopsis and to give the reader and the present and future polar traveler many details of serious polar work that it was impossible to embody in my former popular narratives without crowding out other and, as it seemed, more important matters.

Some of the things that will be described are well known to all polar explorers who have had serious practice, while others will be new to all except those who have had opportunities to obtain the information by personal conversation with members of my parties.

In extending the scope of the present book to touch on polar exploration, it seems well to post the reader at the very beginning on the striking antitheses of natural conditions, apparently known to only a few even among the best read and most intelligent people, existing at those mathematical points, the north and south poles, where the earth's axis intersects the surface of the earth.

The north pole is situated in an ocean of some fifteen hundred miles' diameter, surrounded by land. The south pole is situated in a continent of some twenty-five hundred miles' diameter, surrounded by water. At the north pole I stood upon the frozen surface of an ocean *more than two miles in depth.* At the south pole, Amundsen and Scott stood upon the surface of a great, snow

plateau *more than two miles above sea-level.* The lands that surround the north polar ocean have comparatively abundant life. Musk-oxen, reindeer, polar bears, wolves, foxes, arctic hares, ermines, and lemmings, together with insects and flowers, are found within five hundred miles of the pole. On the great south polar continent no form of animal life appears to exist.

Permanent human life exists within some seven hundred miles of the north pole; none is found within twenty-three hundred miles of the south pole. The history of arctic exploration goes back nearly four hundred years. The history of antarctic efforts covers a little more than one hundred and forty years. The record of arctic exploration is studded with crushed and foundering ships and the deaths of hundreds of brave men. The records of antarctic exploration show the loss of only three ships and the death of a score or more men.

For all those who aspire to the north pole the road lies over the frozen surface of an ocean the ice on which breaks up completely every summer, drifting about under the influence of wind and tide, and may crack into numerous fissures and lanes of open water at any time, even in the depth of the severest winter, under the influence of storms. For those who aspire to the south pole the road lies over an eternal, immovable surface, the latter part rising ten thousand and eleven

thousand feet above sea-level. And herein lies the inestimable advantage to the south polar explorer which enables him to make his depots at convenient distances, and thus lighten his load and increase his speed.

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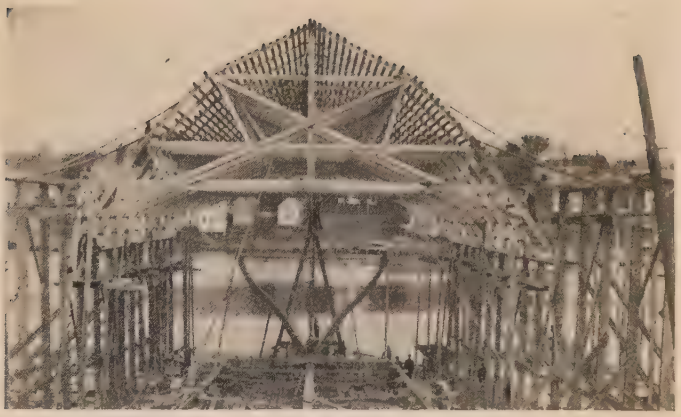
SECRETS OF POLAR TRAVEL

no place is slighted, that, when it is done, he may have that delight of a seaman, a tight ship. He should pass sleepless nights going over again and again the calculations for his engines and boilers; and in checking and rechecking weights, dimensions, displacement.

In this way, by following every step of the ship's growth, and sitting up night after night studying every detail with a view to improving and strengthening it, when the work is done, he will know every inch of his ship inside and out. Later, in the grim, protracted fight with the ice, he will feel in regard to his ship as Sullivan and Willard each felt on the eve of a great battle regarding his powerful body, that it can be depended upon absolutely. It is a wonderfully satisfactory feeling, and it counts far toward success.

A quite general idea regarding the work of a polar ship seems to be that such a ship breaks up the ice of one season, like river and harbor ice-breakers. As a matter of fact, smooth, unbroken ice of uniform thickness is rarely found in Northern voyages except in Melville Bay, or at the end of the season, when new ice is forming. The chief work of a polar ship is to push and pry and wedge its way in and out among cakes and floes ranging from three to twenty or fifty and even up to one hundred and twenty feet thick. A passage cannot be smashed through such ice, and nothing remains but to squeeze and twist and dodge



BEGINNING OF THE "ROOSEVELT"
First frame erected, ship now under construction, Bucksport, Maine, October, 1914

MIDSHIPS CROSS SECTION OF THE "ROOSEVELT"
Looking aft. Note section nearly a semi-circle

through it. A hundred Yermaks (the powerful Russian ice breaker) merged in one could accomplish nothing in such ice.

Many qualities are necessary in a first-class polar ice-fighter. First, there must be such a generally rounded model as will rise readily when squeezed, and thus escape the death-crush of the ice. Then there must be no projection of keel or other part to give the ice an opportunity to get a grip, or to hold the ship from rising.

When the *Jeannette* was destroyed northeast of the New Siberian Islands, the ice on one side of her caught and held her firmly, while the floe on the other side, turning down under her side, caught the keel, and with its resistless pressure opened up the ship her entire length along the garboard-strake. She then filled, and when the ice pressure was released she sank.

The polar ship must be most heavily braced and trussed to enable it to withstand terrific pressure of ice-floes, and hold its shape until the pressure is released by the rising of the ship; or to make it possible for her to be supported at each end only or in the middle, or thrown out on to the ice, so she would rest on her bilge during a convulsion of the floes, without strain or injury. Power and strength and solidity to fight a way through ice rather than drift inertly with it, are absolutely essential. For ramming, she must have a sharply raking stem, which will rise on the ice

at each blow. This not only makes it possible for a loaded ship to deliver blows at full speed without danger of smashing in her bows or starting her fastenings or seams, but also gives her an initial impetus astern when she backs for another blow.

When it is understood that this ramming may continue for hours (I have used my ship in this way continuously for twenty-four hours in crossing Melville Bay), striking a blow, backing, then going ahead full speed for another, the value of this little assistance with each blow will be appreciated. The shape of the bow is also important in ramming. If too bluff, headway is deadened, and the force of the blows is lessened. If too sharp, the ship may stick at each blow, and require more time and power to back out each time. The run of the polar ship should be full rather than fine, to keep the passing ice away from the propeller as much as possible.

The ship must be as short as practicable and have a lively helm to enable her to twist and turn rapidly and shave through the narrow, tortuous lanes of water among the ice-fields.

It will be seen at once that a ship for arctic or antarctic work must be as small as the size of the party and the amount of supplies, equipment, and coal for the proposed work will permit. The smaller a ship can be built, the greater will be her strength and the ease with which she can be handled.

Finally the polar ship must be a good sea boat to ride out the furious autumn gales of the North Atlantic and polar oceans.

This is especially important in South Polar work with its long voyage and cyclonic blizzards.

Many are under the impression that steel should be used in constructing polar ships. This idea is erroneous, for though a ship so made would be strong structurally, she would be particularly vulnerable to the ragged, sharp corners of heavy ice. Wood, with its elasticity and toughness, is the prime essential in the construction of a ship of this kind. It is also virtually impossible to repair injury to a steel ship during the voyage. But steel and methods of composite ship building, used in a vessel's interior, may reduce weight and increase her strength.

Numbers of failures and catastrophes in polar work are directly attributable to the unsuitable model of the ship. Particularly striking examples of this were the *Polaris* and the *Jeannette*. Neither of these ships should ever have been allowed to go into the ice, as their straight sides gave them no possible chance to lift when squeezed by the ice, and their destruction was only a matter of time, when they should be squarely caught between two floes. In the case of the *Jeannette* Melville's engineering skill postponed the catastrophe for a time, but the final result was inevitable.

The *Esquimaux* of the Ziegler Expedition and the Duke of the Abruzzi's *Stella Polare* were scarcely better, but the skill of the Italians enabled their ship to pull through and bring the party home.

Virtually all the ships used in the history of ice navigation have been the sailing-vessels built in Scotland, Norway, and the United States for the whaling and sealing industries. These whalers were short, stocky, heavily sparred, and square rigged. The *Victory,* used by John Ross, in 1829, was fitted with auxiliary steam-power, and was the first attempt to utilize such motive power for ice work. The innovation of steam with paddle-wheels, than which nothing could have been more impracticable for ice navigation, proved a decided failure, and the engine was finally torn out and thrown overboard, and the voyage continued under sail.

The Norwegians operating in the waters about Spitzbergen, Jan Mayen, and Nova Zembla; the Americans, in Bering Sea and Hudson Bay, encountered ice conditions strikingly different from those met by the Scotch whose region of operations was chiefly in Davis Strait, Baffin Bay, Lancaster Sound, together with their tributaries, and the seas about eastern Greenland. Broadly speaking, the work of Norwegians and Americans was carried on among floes and broken ice drifting in open seas, through which they had to thread their

STEM, FOREFOOT, AND BOW FRAMES
January 11, 1905

MASSIVE KING-POST TRUSSES STRENGTHENING THE "ROOSEVELT'S" SIDES AGAINST ICE PRESSURE
The horiontal timber in center of picture is 14 in. x 16 in.

way, while the Scotch in Melville Bay encountered an almost solid stretch of one season's ice, and in the narrow, land-locked channels to the westward the currents of which are notoriously strong, they had to contend with old and heavier ice. Some one has very aptly said that American whalers used steam to avoid ice, the Scotch, to go into and through it.

The following average proportions of beam to length among these whalers is rather interesting: Scotch, 1:5.75; Norwegian, 1:4.7; American, 1:4.5. The average ratio in modern schooners built in Bath is 1:4.78.

The Scotch, thanks to the shrewdness of their seamen and builders and over one hundred years of experience in whaling work, where the best ships secured large financial returns, have gradually evolved the more powerful and efficient type of ship, and this type has been used exclusively by the British even in their latest expeditions.

It had long been a recognized fact that a form of hull which would permit a ship to rise readily and easily under pressure was desirable; yet the *Fram* was the first ship built to meet this requirement. The *Fram* was built with a special view to drifting in and with the ice. Her beam was about one-third her length, and her hull was so designed as to allow her to rise easily under pressure. While she was well adapted for this work, she would have been still better fitted for it if she

had been bowl-shaped. Moreover, appearance, speed, ability to push through the ice, and virtually everything that goes to make a ship seaworthy was sacrificed to insure this quality.

The *Gauss,* the German antarctic ship, was much like the *Fram,* though less pronounced in type, having a broad beam of 36 feet, but with a greater length to make her more seaworthy for the long voyage to the antarctic regions. Her ratio is 1:4.25 as compared with the *Fram's* ratio of 1:3.25.

The British *Discovery,* built for antarctic exploration, was also of the sailing type, with auxiliary steam-power. She was built with a little broader beam and a draft slightly less than that of the Scotch whalers, with a ratio of 1:5.27. She differed from the *Fram* and the *Gauss* in that she was not specially constructed to rise under pressure, and the rake of her stem was somewhat greater than in previous ships.

With the building of the *Roosevelt* came a complete reversal of former practice in ships for the arctic and antarctic regions. She was the first Polar ship built that was first of all a powerful steamer. All her predecessors had been sailing-vessels, usually full-rigged barks, with steam as a secondary consideration. This was done to economize on coal and enable the ship to cover long distances at slow speed and be gone for years, if necessary.

In the *Roosevelt* sail power was a mere auxiliary, and everything was given over to making steam-power first and foremost and her strength sufficient to withstand the ice. This is undoubtedly the correct principle on which to build any Polar ship for effective results. For this method the Smith Sound route is specially advantageous, affording a coasting voyage, ample facilities for caching coal, as well as presenting opportunities to obtain coal en route.

As the *Roosevelt* was to be built for navigating the very seas where the Scotch gained their valuable experience and for which their ships were specially designed and improved, the Scotch model seemed the proper one to use as a base for studies.

In the case of Nansen, and the British and German polar expeditions, the size of the ship was determined by fixing the size of the party, the length of the expedition, and the amount of coal which would be consumed by the engines and the cargo to be carried, all of which factors, when the dead weight of the ship and machinery was added, would give the displacement required.

In the case of the *Roosevelt* I believed it advisable to settle in advance the size and proportions which would come nearest to balancing and meeting the various requirements, allowing the difference between her displacement and her dead weight to go for cargo capacity, chief of which would be coal. The size determined was 184 feet

over all, with 35 feet beam and 16 feet draft, loaded, and a load water-line of 166 feet. These dimensions make her almost as long as, but with a slightly greater beam than, the *Discovery,* the British antarctic ship. Her length ratio, while not quite as fine as that of the Scotch model, is much finer than the Norwegian or American averages.

After determining her length and beam, came the question of draft. For the ship navigating the waters of Smith Sound a light draft is far better than a heavier one, permitting her to hug the shore in order to get round barriers, or, when crowded by heavy ice, to retreat close to the shore and let it ground outside the ship. Another distinct advantage of light draft in a ship is the greater ease with which she will rise under the heavy pressure of ice-floes. The greater her draft, the harder it is for her to rise and avoid the grip of the ice.

So much depends on the ship in the serious work of ice navigation that it may be well to describe in detail the ship which I consider the ablest of ice fighters.

The official measurements of the *Roosevelt* are as follows: length, 184 feet; breadth, 35.5 feet; depth, 16.2 feet; gross registered tonnage, 614 tons; maximum load displacement, about 1500 tons. The keel, main keelsons, stem- and stern-posts, frames, plank sheer, waterways, and gar-

BOW OF "ROOSEVELT" IN DRY DOCK
Note massiveness and rounded, egg-like curves

board-strake, are white oak. Beams, sister-keelsons, deck clamps, 'tween-deck waterways, bilge-strakes, ceiling, and inner course of planking, are yellow pine. The outer planking is white oak and the decks of Oregon pine. Both the ceiling and the outer course of white-oak planking are edge-bolted from stem to stern, and from plank sheer to garboard-strake. The fastenings are galvanized iron bolts, going through both courses of planking and the frames, and riveting up over washers on the inside of the ceiling.

The great oak timbers of the keel, false keel and keelsons, bolted and strapped and scarfed together in every way that experience and ingenuity could suggest formed a rigid backbone over six feet high. The oak timber sources were searched to secure these timbers, and some of them perhaps could not be duplicated to-day.

Massive oak timbers formed the stem, stern and rudder posts, bolted and strapped to each other and to the keel.

The frames or ribs of the *Roosevelt* were placed almost close together, each made of three courses of selected timbers bolted together.

At the stem the ribs were close together and the triangular space at the bow between the port and starboard ribs was filled in solid for a distance of some ten feet aft of the stem with oak timbers bolted and scarfed together to make a solid ram, or fighting head or cæstus.

Main deck beams and 'tween deck beams were unusually large and spaced unusually close together. The latter were placed on a water line instead of with a sheer, so that they were just below the load water line where the severest and most frequent ice pressure would come.

Each main deck beam together with the 'tween deck beam below it, and four stout diagonal braces to the ship's sides and a 2½" vertical steel tie-rod from the bottom of the keel to the upper side of the deck binding all together, formed a double king post truss, one superimposed upon the other.

This truss arrangement was made possible by my method of housing the personnel of the expedition in light roomy quarters on deck, rather than below the decks.

The sides of the ship varied from twenty-four to thirty inches in thickness. These sides, supported at every four feet of the ship's length by the truss system above described, and still further reinforced by three solid timber transverse bulkheads, were immune from being crushed in.

To avoid unnecessary weight, no planking was used between decks; there were no interior fittings; and spars and rigging were as lightly made as possible. The hatch coamings were of stout white oak, built almost as high as the top of the bulwarks, to add to the safety of the ship in heavy weather.

To protect her planks from the gnawing of the

ice while steaming through it, as well as to reduce friction, the ship was surrounded at the water line with an armor belt of dense slippery greenheart.

This wood imported from Guiana expressly for the purpose, is so tough and dense that spikes or bolts cannot be driven into it but must have holes bored for them.

The shipyard which puts on the greenheart usually has to get a new set of saws, planers and drills for the next job, and the echoes of profanity linger for a long time.

The massive construction of the *Roosevelt* so impressed the inhabitants of Bucksport, accustomed to usual ship building, that one of the village oracles is to said to have delivered himself around the glowing stove of the "hotel" office of the following, "By heck there 's so much wood in the d—— ship that she 'll sink when they launch her."

After the hull of the *Roosevelt* was completed, she was put into dry-dock and "watered"; that is, water was pumped into her to detect any bolt-holes that had not been filled with a bolt, or any seam that had been overlooked in calking, just as one would test a pail by filling it with water to see if it leaked.

By this test leaks are located that cannot be detected in any other way, and the explorer during his voyage is saved the maddening annoyance of listening to the trickling of incoming water as he

lies in his bunk at night, of the daily clank of the pumps, and of a ship with bilges full of ice at the end of the Polar winter.

In regard to engine power, my ideas have been radically different from those of other navigators. I have believed in all the power it was possible to get into the ship. I know of few more comfortable feelings for the commander of a ship beset in the ice than the knowledge that he has beneath his feet the power that with the least slackening of the ice pressure will enable him to force his ship ahead on her course.

The motive power of the *Roosevelt* consisted of a single, inverted, compound engine, capable of developing a thousand horse-power, and driving an eleven-foot four-blade propeller. Two water-tube boilers and one Scotch boiler supplied steam.

Two specially distinctive features of the machinery of the *Roosevelt* were a large "by-pass," by means of which, by turning a valve, steam from all the boilers at full pressure could be turned directly into the big fifty-two-inch low-pressure cylinder, more than doubling the power for a short time; that is, as long as the boilers could meet this excessive demand. The object of this was to give me a reserve of power with which to extricate the ship from a particularly dangerous position. On at least two occasions this device accomplished all that was expected of it,

STERN OF "ROOSEVELT" IN DRY DOCK

Note rounded curves, massiveness of propeller, skeg and rudder, and lavish use of steel plates. Rudder is of white oak timbers 16 in. x 16 in.

and, by resistlessly forging the ship ahead a length or two against all odds, removed her from the line of deadly pressure, and so saved her.

The other was an enormously heavy and strong propeller and shaft. The shaft was a twelve-inch diameter solid steel forging, a shaft big enough for a 2000-ton tramp steamer. The propeller was correspondingly heavy. The object of this was to prevent the complete crippling of the ship by breaking of shaft or propeller.

This idea entailed unusual weight and expense, but it served its purpose and was never regretted.

When in July, 1906, the *Roosevelt* was smashed against the unyielding ice-foot at Cape Union, tossed about like an egg-shell, and treated generally as if she were of no account, a particularly vicious corner of an old floe struck her astern, broke one propeller-blade square off, tore off the ponderous white-oak skeg, or after stern-post, and, catching under propeller and projecting end of shaft, lifted the whole after part of the ship as a man would lift a wheel-barrow, until her heel was out of water, and held her in this way for several hours until the tide changed. Had propeller and shaft been of usual proportions, neither would ever have made another revolution. As it was, my twelve-inch shaft was not even thrown out of line, and barring the broken propeller-blade, the machinery suffered no damage.

Another device which added to the effectiveness

of the *Roosevelt* is the arrangement for raising and lowering the rudder while at sea, or lifting it when under pressure in the ice. A large open well was provided, reaching through to the main-deck. This was large enough to permit the massive rudder to be drawn up and hoisted on the deck for repairs, or into the overhang of the stern, out of the way of the ice. Instead of having to send a diver down to unfasten the gudgeons, these worked in an upright groove arranged in the after end of the stern-post, something like a window-sash. Heavy bolts attached the pintles to the rudder-post, and in unshipping the rudder, the gudgeons came up with the rudder itself, leaving the raking steel-clad stern-post as smooth and clean as the stem, with nothing for the ice to get a grip upon.

The problem of protecting the propeller-blades and keeping ice away from them, was solved partly by the full counter and overhanging stern of the *Roosevelt,* and partly by the design of the propeller. The blades of the propeller, though short, were large in sectional area, and particularly strong and massive. Their extremities were so shaped as to make it difficult for a cake of ice to get between them, and the blades were so arranged that either two or four of them could be used.

Powerful deck appliances were the windlass, steam-capstans forward and aft, and steamwinch, which enabled the ship to float herself should

she get aground, or to warp herself out of a dangerous spot.

The special features of the *Roosevelt's* model are a smooth and rounded form not readily gripped by the ice; midships transverse section that is a semi-circle; a sharply raking heavily steel clad stem and stern post giving large deck room, sufficient water line displacement and a short keel which makes the ship quick and handy in turning; an overhanging stern to assist in protecting rudder and propeller from the ice.

Her peculiarities of construction include unusually massive and close arrangement of beams and bracing to withstand pressure on the sides; filling the bow in almost solid with iron and timbers, where it gets the brunt of blows; strong and unusual reinforcement of the rudder-post; the introduction of a lifting rudder; heavy steel plates for stem and bow; a course of greenhart ice-sheathing to protect the outer planking.

Her peculiarities of rig are pole-masts; three-masted schooner rig, with big balloon staysails; and a very short bowsprit, which, when navigating through ice of some height, can be run inboard.

Her sail-plan is an American three-masted schooner rig, of light weight (a decided advantage when every pound saved in weight in rigging or fittings means an extra pound of coal on board), large enough to assist the engines considerably in

favorable weather, or to get the ship home in case of her supply of coal becoming depleted.

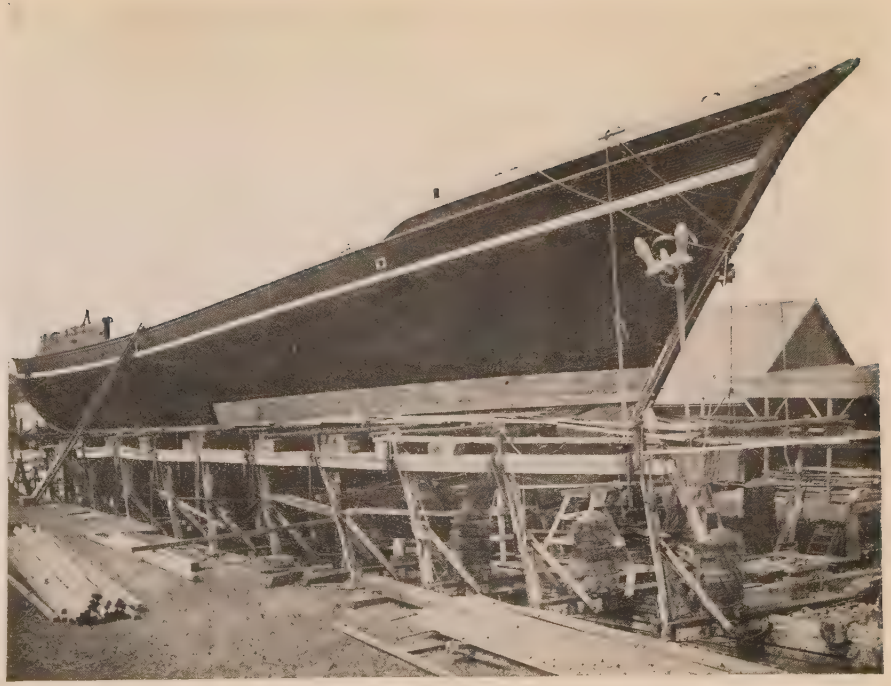
The whole scheme on which the *Roosevelt* was built was to place all her strength, power, weight, carrying capacity below the main-deck; to make everything above deck, such as bulwarks, spars, sails, rigging, whale-boats, with their equipment, and deck-houses, as light as possible, in order to allow more coal to be stowed on board, and to waste no money on frills or fittings, but to use every dollar in the interests of strength, power, and effectiveness.

Constructed of southern oak and yellow pine, New England white pine and Oregon pine, by New England labor, the *Roosevelt* as a thoroughly American ship combines the qualities of shape which as in the *Fram* insure her rising under heavy ice pressure, with the splendid ramming qualities of the best of the Scotch whalers. These permit the ship to be fearlessly driven into the ice with all the force of her powerful engines.

The *Roosevelt* embodies all that a most careful study of previous polar ships and my own years of personal experience could suggest.

With the sturdiness of a battleship and the shapely lines of a Maine built schooner, I regard her the fittest icefighter afloat.

As I write these lines, I see her slowly but surely forcing a way through the crowding ice. I see the black hull hove out bodily onto the sur-



PUTTING ON THE GREENHEART ICE-SHEATHING

This view shows the sharpness of the bows and the pronounced rake of the stem

face of the ice by a cataclysm of the great floes. I see her squeezed as by a giant's hand against a rocky shore till every rib and timber is vocal with the strain.

And I see her out in the North Atlantic lying to for days through a wild autumn northeaster, rudderless, with damaged propeller, and shattered stern post, all pumps going, a scrap of double reefed foresail keeping her up to the wind, riding the huge waves like a seagull till they are tired out.

After my return from the north pole in 1909, the *Roosevelt* was purchased from the Peary Arctic Club, which had built her for me, by John Arbuckle, the great tea, coffee, and sugar merchant of Brooklyn.

Mr. Arbuckle's personal hobby was wrecking. He desired the *Roosevelt* as a powerful ocean-going wrecking-tug. He made some changes in her rigging, removing the mainmast completely, and replacing the foremast with a powerful boom derrick. Air-compressors and additional powerful winches were installed upon her deck. Thus equipped, the *Roosevelt* assisted in the attempts to save the *Yankee,* and salvaged other wrecks along the coast as far south as Florida.

Mr. Arbuckle's death put a stop to this work, and for a year or two the *Roosevelt* and other craft of his wrecking fleet lay in a Brooklyn slip almost under the east end of the Brooklyn Bridge,

where thousands of passers-by could look almost directly down into her big, elliptical smoke-stack.

Then the *Roosevelt* was purchased by the Bureau of Fisheries of the Department of Commerce for an Alaskan patrol-boat. The bureau changed the *Roosevelt* to an oil-burner, restored her foremast, and made some minor changes in her accommodations for officers and men.

For a time she made her headquarters at Norfolk, Virginia, whence she went out on various fisheries trips. In the spring of 1917 she went through the Panama Canal, and proceeded to Seattle, Washington, to fit out for her work of patrolling the Alaskan coast, carrying supplies to the various stations and settlements, inspecting the canneries and seal-rookeries, and giving assistance, when necessary, to ships along that coast. For this work the *Roosevelt* is specially adapted, and will be able to perform her duties in all weathers and at all seasons of the year.

While waiting at Seattle, the *Roosevelt* took part in an important local event, carrying the official party and leading the naval pageant on the occasion of the opening of the Lake Washington ship canal connecting the lake with Puget Sound, and giving Seattle a double water front.

I was on board the *Roosevelt* for an hour late in May, and as I stood again on the bridge the succession of scenes that passed before me was as rapid as the changing pictures of a movie.

I was much pleased to have the Government take over the *Roosevelt*. Naturally my feeling for the ship was strong; yet I personally had neither the means to purchase her nor to maintain her after purchase. Nor did I feel like suggesting to the friends who had splendidly furnished the money for the discovery of the pole that the ship be purchased and taken care of.

From time to time I receive letters suggesting some action—public subscription or otherwise—for the maintenance and preservation of the *Roosevelt* as a national object of interest. These letters have referred to the government ownership by Italy of Abruzzi's *Stella Polare,* by Norway of Nansen's *Fram,* and by England of Nelson's *Victory;* but none of these suggestions ever materialized.

Some day it is my hope to build a *Roosevelt II* to carry the Stars and Stripes around and into the heart of the antarctic regions. Drawings for such a ship, both in general and in detail, based on my experience in designing, building, and using the *Roosevelt,* were one of my amusements and occupations during the two long winter nights which the ship spent at Cape Sheridan. These plans contain a number of new ideas and improvements over the *Roosevelt.* The actual sail-plan, cross-section and longitudinal models to the scale of a quarter of an inch to the foot, are now stored on Eagle Island.

On the conclusion of the war, with the new impetus that has been given to wooden ship-building, perhaps it may be possible to realize these ideas, and send a ship south that will place the name of the United States high in the record of antarctic work. Such a ship, under command of Bartlett, and utilizing the experience gained and the methods developed in twenty-three years of north polar work, could probably do in a given time twice as much work as any existing ship.

There are three pieces of antarctic work of major importance and of great attractiveness that lie ready to the hand of the United States whenever we are ready to undertake them.

One is the complete delimitation of the great Weddell Sea indentation in the antarctic continent lying southeast of Cape Horn. Another is the establishment of a station at the south pole for a year of continuous, systematic scientific observations. A third is the exploration, survey, and study through several seasons of the entire periphery of the antarctic continent.

The first of these, the exploration of Weddell Sea, which thus far has baffled the efforts of every expedition, Scotch, German, French, Swedish, and British, is, from its location in the Western Hemisphere, in our sphere of influence, and would also be likely to give the maximum amount of general results in the shortest time and at the least expense.

BOW OF THE "ROOSEVELT" IN ICE
Impressive in its massive sturdiness and evident power

LAUNCHING THE "ROOSEVELT"
Bucksport, Maine, March 23, 1905. Very appropriate that the baptism of the ship should be in ice-filled water

The second, an observation station at the pole, might be an adjunct of the first, an overland party from the head of Weddell Sea establishing and provisioning the station. The traverse of such a party from the head of Weddell Sea to the south pole would, with the journeys of Amundsen, Scott, and Shackleton from McMurdo Sound on the opposite side, give a complete cross section of the antarctic continent.

The natural conditions in the antarctic region, that is, a continuous permanent surface from year to year, as compared with the north polar ocean, which may become intersected with lanes of open water at any time as the result of a storm—makes it possible for a party equipped like my north-pole party, to establish and maintain a regular route and system of transporting supplies right through the antarctic night. Or a few aëroplanes, working from a base at the head of Weddell Sea, could in a few weeks of the antarctic summer provision such a station for a year, as British planes in the Mesopotamia campaign carried supplies to Kut-el-amara.

Such a station, by making simultaneous observations with other existing stations, ought to add greatly to our meteorological and magnetic knowledge. If at the same time a similar station at Cape Columbia, the most northerly easily accessible point of land in the arctic regions, should be established, and take synchronous observations,

the value of all would be still further increased.

The Cape Columbia station like the one at the south pole could be established and provisioned by aëroplanes in a few weeks from Whale Sound less than 400 miles distant and easily accessible every summer. With two such stations at the extremities of the globe observing simultaneously with selected stations in the inhabited portions of the world, there would certainly result a broader knowledge of meteorological, magnetic, and other natural conditions. The proposition has the approval of distinguished scientists, and will undoubtedly be eventually put in execution.

The third proposition, a complete systematic study of the entire periphery of the antarctic continent and its adjacent waters by a party of scientific experts in a special ship during a succession of seasons, would appeal most strongly to the scientists and museums of the country.

It would be an American *Challenger* expedition, with all the improvements and widened horizon of investigation that forty-four years of scientific progress represent. Such an expedition with good fortune could complete the circuit of the Antarctic continent in three or four seasons, coming north to pass each winter at some convenient port as Punta Arenas in the Straits of Magellan; Wellington, N. Z.; Hobart, Tasmania and Cape Town.

Each year the observations and collections could

be sent home, and any necessary changes be made in the personnel.

The materialization of this program will give our museums a large amount of valuable material from a region which at present is most meagerly represented in their collections, and will furnish our scientists with material and observations to keep them occupied for years.

The financing of the work could be met by a group of American museums. Or it presents an opportunity for some man of means to place himself permanently in the scientific record of the nation by furnishing the funds for its realization.

CHAPTER II

SELECTING MEN

IN my polar parties the matter of personnel has been different from that of other expeditions because of my extensive utilization of the Eskimos. From the beginning of my interest in polar matters my conception of an ideal polar party was one in which the rank and file should be composed of Eskimos, with one or more white men in command.

But I was not able to realize this ideal at the start of my polar work, and in my first expedition the entire work was done by the six members of my party. In my second expedition the Eskimos assisted for a short distance on the ice-cap. In the work and journeys of my long expedition of 1898–1902 (four years, three months, and seventeen days), my plans crystallized into actual shape, and all parties were made up of Eskimos and a white man or two, sometimes one member of my party commanding fifteen or sixteen Eskimos. In my last two expeditions of 1905–06 and 1908–09 the system was still further perfected.

In these last two expeditions another phase entered. With the close of my 1898–1902 expedi-

Courtesy of the American Museum of Natural History

CAPTAIN ROBERT BARTLETT

tion I had worked out the ultimate possibilities of sledging from a base south of the 79th parallel, and recognized that the pole could not be reached from such a base. The preliminary journey from the base to the most northern land made too serious a drain upon the energies of dogs and men to enable them to negotiate the final and most difficult part of the journey over the surface of the polar ocean. The only answer to the problem was a ship which would put me within striking distance of the pole.

The result was the *Roosevelt,* and in my last two expeditions the presence of a ship added to the personnel of my expedition the new element of ship's officers and crew. Thus in the final evolution of my work my parties were made up of three elements: myself and my assistants for the exploration sledge-work; the ship's officers and crew; and the Eskimos, these last being more numerous than both the others combined.

The Eskimo element is taken up more fully in another place, and I shall not go into it here. The selection of the ship's personnel threw no burden of time or attention on my shoulders, as, with the exception of the chief engineer and his assistant, whom I myself selected, and who were Americans, I turned this matter over to Bartlett, himself a Newfoundlander, and held him responsible for a picked crew of these ideal, hardy ice-navigators.

In the general scheme of work it was not ex-

pected that any of this ship personnel should take part in the sledging expeditions. Bartlett's eagerness to have a share in the sledge work, however, together with his personal qualifications, made him an invaluable addition to my field parties, and two or three of the men before the mast volunteered for, and did good, preliminary depot and hunting work.

My own particular work of selecting personnel was confined, therefore, to the limited number of my own assistants, and in the last expedition three of these, Henson, Percy, Marvin (I mention them in the order of length of service), were tried and faithful men from previous expeditions.

The day of large parties in successful polar work has passed. Effective results in these regions can, and in the future will be, obtained by very small parties. The records of some of the earlier expeditions show the fallacy of the popular idea that there is safety in numbers.

Franklin's party of 138 men, the largest in the history of polar exploration, equipped with everything that the ample resources of the British Government could provide in that day, met with disaster, not a single member surviving to tell the fate which overtook them. Too large a party was, in my opinion, the direct cause of the utter loss of this expedition, and many of the tragedies which have preceded and followed it would not have occurred had the parties been small ones.

The whole situation in polar regions is against large parties. Starvation is inevitable when, as a result of the loss of ship or supplies, a large number of men find themselves dependent upon the resources of the country even for a short time, whereas a small company would have an abundant food-supply. On more than one occasion, on long sledge journeys with one or two companions, a single hare has made a hearty meal for us, which, followed by a good sleep, made it possible for us to travel some days more without meat. Had there been five or six of us, the portion of each would only have aggravated our hunger, and the strength and endurance of none would have been materially increased.

An illustration of this is an incident in the land beyond the ice-cap on my second trip across northern Greenland. Five hundred miles separated me and my companions from any other human beings. Then I wrote:

I saw a fresh hare-track, and a few hundred yards beyond came upon the hare itself, squatting among the rocks a few paces distant. With the sight of the beautiful, spotless little animal, the feeling of emptiness in the region of my stomach increased. I called to Matt, who was some little distance back, to stop the dogs and come up with his rifle. He was so affected by the prospect of a good supper that, though usually a good shot, his first and second bullets missed the mark; but at the third the white object collapsed into a shapeless mass, and on the instant gaunt hunger leaped upon us like a starving wolf upon its prey. A little pond, surrounded by high banks a short distance away, offered the advantage of ice for cooking

purposes, and here we camped, lit our lamp, and cooked and ate the entire hare. It was the first full meal we had had since the Eskimos left us thirty-five days ago—the first meal possessing proper substance and staying quality to fit a man for a heavy day's work.

While we were enjoying our feast, it began snowing, and at its conclusion we lay down as we were, upon the snow-covered shore of the little pond, without tent or sleeping-bag or anything except the clothes we wore, and, with the snowflakes falling thickly upon us, slept.

Demoralization is also much more easily caused by a disloyal or cowardly member in a large party than in a small one. The success of any expedition depends upon the magnetism and force of its leader. His example is contagious, his courage, activity, and cheerfulness being reflected in each person of his party up to a certain mark.

But the infusion of fresh courage into a member whose mental and physical strength has been impaired by cold, hunger, or discouragement is a drain upon the leader's nerve force. The larger the party, the more difficult it becomes to fill it with courage and hopefulness when confronted by serious disappointment or disaster, or to put down insubordination. The impetus of a sledge party in particular centers in the physical condition of its leader, and my various sledge-journeys have shown me how vital it is that things that drain his energies should be reduced to a minimum.

Next after the leader and a suitable ship, is an ice master, and an ice navigator must be born to the art.

MATTHEW A. HENSON

HENSON IN FULL WINTER COSTUME WITH SNOWSHOES

He must possess good judgment, nerve, endurance, quick decision, and an uncanny prevision as to what the ice is going to do next.

Bartlett is the type I have in mind, accustomed to the ice and to ships from his early teens, wide experience in different portions of the globe, great endurance, abundant nerve, good judgment, and with the intensive training and experience of two voyages with me in what is probably the worst ice-navigation of the north polar regions.

To this has now been added his unusual experience during his voyage in the *Karluk* in Bering Sea.

Much has been accomplished by small parties in polar work. Schwatka made his great sledge-journey with four white men and an Eskimo. Captain Holm made his eastern Greenland trip with four men; Payer's party of seven in Franz-Josef Land was found impracticable, and was reduced to three. Striking examples of what *one* determined man can accomplish are found in the records of Hall's early explorations and Graah's sledge-trip along the eastern coast of Greenland. Nansen's most striking work was done with a party of two. Captain Cagni's main party to the then highest north, 86° 34′, numbered four. Amundsen reached the south pole with a party of five. Scott's south pole party numbered five. Stefansson did valuable work through several years with one companion. My own work has

been done with from two to six in the party, the latter being the number in my north pole party.

I have always limited my parties to the number absolutely necessary for the work I had laid out, believing that every addition means an element of danger and failure. My reconnaissance of the Greenland inland ice in 1886, resulting in the penetration of the ice-cap to a greater distance than ever before by a white man, and the attainment of the greatest elevation on the ice-cap, was made with only one companion.

My Greenland expedition in 1891–92, the record of which includes the determination of the insularity of Greenland, a survey of Inglefield Gulf and Whale and Murchison sounds, the first accurate and complete record of the arctic Highlanders, was composed of seven members. And the 1200-mile sledge-trip across the Greenland inland ice-cap was accomplished by me and one companion.

The work of my expedition of 1893–95, covering a period of twenty-five months, included a second sledge-journey of 1200 miles across the ice-cap, the discovery of the Cape York meteorites, the completion of the survey of the region about Whale Sound, and the completion of the study of the natives. There were fourteen members in this party, eleven of them returning in August, 1894, leaving three of us to carry on the work for the last year. Summer trips were made in 1896

and 1897 to secure the last and largest of the meteorites. There were five men in the first party, seven in the last.

Twenty-one white men, including the crew and firemen of the *Roosevelt,* and forty Eskimos made up the personnel of my 1905–06 expedition, which resulted in the attainment of "farthest north." The personnel of my last and successful attempt to reach the pole (1908–09) included twenty-two white men and forty-nine Eskimos.

As to the quality of the personnel of a polar expedition, my experience has proved over and over again the accuracy of my theory that it should be made up wholly of young men, of first-class physique, perfect health, education, and attainment. Such men, interested in their work and the success of the expedition, with resources within themselves and plans for the future, are able to resist in a large measure the depressing effects of the long polar night, and in field-work their enthusiasm more than makes up for lack of experience or toughened endurance.

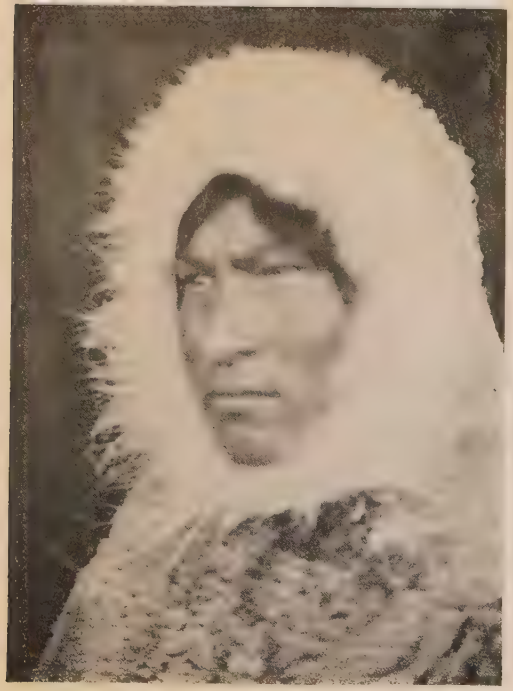
To nine out of ten the word polar is synonymous with cold. To one who has spent a year within the arctic or antarctic it is more likely to be synonymous with darkness. Any healthy man properly fed and clothed can pass the year in these regions with little discomfort so far as the cold is concerned. But when it comes to almost four months of polar night, it is different. A man of

the most sanguine temperament cannot avoid entirely its effects, and there are those of nervous temperament whom a night in the arctic would drive insane. Not that it is so extremely dark, for the three or four winter moons give a brilliant light, and at other times the darkness is not greater than at home on starlit nights in the winter. It is only during heavy storms that the darkness becomes intense and tangible. It is the absence of the actinic or the physiological effects of the sun's rays and the contraction of the physical horizon by the darkness which render a polar night so trying. As far as I was able I have selected blondes for the personnel of all my expeditions.

Men for the field-parties should be wiry, and their weight should be within the limits of not less than two pounds, nor more than two and a half pounds per inch of height. This means for a six-foot man a minimum of 144 pounds, a maximum of 180 pounds, and a mean of 162 pounds.

When I returned from the north pole sledge-trip, which was a trip of arduous and protracted exertion, but not a journey on half-rations, as had been the case on some of my earlier trips, my own weight, stripped to the buff, was 160 pounds, which, by the way, was the same weight to which I trained for my junior-class crew in college at the age of twenty.

Small, wiry men have a great advantage over



OO-TAH

This photo of my best Eskimo, taken immediately after our return from the North Pole, indicates the type of Eskimo for Polar work. The portrait shows the protecting roll of bearskin about the face

Courtesy of the American Museum of Natural History

GEORGE BORUP

large ones in polar work. The latter require more material for their clothing, and usually eat more than the former. Large men take up more space than small ones, necessitating the building of larger snow igloos when on the march, or the carrying of larger tents than would be needed for a party made up of small men. Every pound in weight beyond the maximum requirement tends to lessen a man's agility; in fact, renders him clumsy and more apt to break his equipment. For instance, if a large man on snow-shoes stumbles, a sudden lunge to save himself more often than not results in a broken snow-shoe. The decided disadvantage which a large man is under in crossing a lead or new ice is apparent. This was brought to mind with striking forcefulness in crossing the "Great Lead" on our return from "farthest north" in 1906, when my little party came the nearest we have ever come to death. Two miles of young ice, which would not for an instant have supported us without snow-shoes, had to be crossed, the party spreading out in widely extended skirmish-line, with fifty or sixty feet between each man, each one of us constantly and smoothly gliding one shoe ahead of the other with the greatest care and evenness of pressure, the undulations going out in every direction through the thin ice as we advanced.

I was the heaviest one in the party,—160 pounds net,—and fortunately I had six-foot snow-shoes.

Yet for a considerable part of the distance I doubted if I should ever reach the firm ice. The chief engineer of the *Roosevelt* was a heavy man, weighing 235 pounds or more, and as we stooped to untie our snow-shoes on firmer ice, one of my Eskimos, Ahngmalokto, turned to me with the remark that if the chief had been with us, he never would have reached firm ice. And he was quite right.

Some Arctic travelers advise against having men who have had previous polar experience, as likely to make them opinionated and insubordinate.

There is much in this, and it is a precept well to be followed particularly if the leader is new at the work. Few men, having had experience in a certain direction and associated in a subordinate position with an inexperienced leader, are big enough to be loyal to their commander.

The usual result is constant slurring criticism which is sure to have its effect upon other members of the expedition, and opposition either direct and active or sullen and passive.

The last man of all is the one who is always wondering whether he will ever get back home or not, and is constantly congratulating himself as a hero because he is in the terrible polar regions and still alive.

I know of no better test of character than a season spent in the polar regions. In these regions

men get to know one another better in a few months than they would in a lifetime at home. There is something about the life which very quickly shows the true caliber of a man. If he is a cur, or has a yellow streak it is sure to come out. In making up my last party I was exceptionally fortunate, for I had the membership of the preceding expedition to select from. Every one was glad to make the success of the expedition first and personal feelings and ambitions secondary. My party was efficient and congenial, and never had I spent a winter in the arctic so free from friction and petty annoyances.

CHAPTER III

SUPPLIES AND EQUIPMENT

THE detail of equipping a polar expedition is like the detail of equipping an army for foreign service, with, however, this difference. After the expedition has cast loose from civilization there is no chance to rectify mistakes or omissions. No rush wires or cables can be sent back to ship this or that article by next train or steamer. The little ship which bears the hopes of a polar expedition must contain in its restricted space everything to supply all the needs of its people for two or three years in a region where nothing can be obtained but meat, and even that only by those who possess the "know how." Even when the needs are reduced to almost primeval simplicity, the multiplicity of essential things is great.

As an illustration of how an article, though so common that, like breathing, we are unaware of it, may be overlooked, it is said that a great polar expedition costing hundreds of thousands of dollars, and fitted out under the supervision of committees of scientists and polar experts, dis-

covered, when it reached its winter quarters, that there was no salt on board except that in the salt pork and beef.

Supplies for a polar expedition comprise primarily equipment and provisions. The latter subdivides again into provisions for ship and headquarters and provisions for sledge-work.

The former are essentially normal, comprising standard commercial supplies, the principal thing being to have the best, and the specialness lies largely in the packing. The latter number only four items, pemmican, compressed tea, condensed milk, hard tack; but they are special in every detail of make and packing, with the exception of the condensed milk.

Here are a few of the items and figures on the list of supplies for one of my last expeditions, flour, 16,000 pounds; coffee, 1000 pounds; tea, 800 pounds; sugar, 10,000 pounds; kerosene, 3500 gallons; bacon, 7000 pounds; biscuit, 10,000 pounds; condensed milk, 100 cases; pemmican, 30,000 pounds; dried fish, 3000 pounds.

To illustrate how normal was our bill of fare on the *Roosevelt* in winter quarters, here is our weekly menu for the winter of 1908–09 (the north pole voyage):

Monday. Breakfast: cereal, beans and brown bread, butter, coffee. Dinner: liver and bacon, macaroni and cheese, bread and butter, tea.

Tuesday. Breakfast: oatmeal, ham and eggs,

bread and butter, coffee. Dinner: corned beef and creamed peas, duff, tea.

Wednesday. Breakfast: choice of two kinds of cereal, fish, forward (that is, for the sailors), sausage, aft (for the members of the expedition), bread and butter, coffee. Dinner: steak and tomatoes, bread and butter, tea.

Thursday. Breakfast: cereal, ham and eggs, bread and butter, coffee. Dinner: corned beef and peas, duff, tea.

Friday. Breakfast: choice of cereal, fish, Hamburger on starboard (our own) table, bread and butter, coffee. Dinner: pea soup, fish, cranberry pie, bread and butter, tea.

Saturday. Breakfast: cereal, meat stew, bread and butter, coffee. Dinner: steak and tomatoes, bread and butter, tea.

Sunday. Breakfast: cereal, "brooze" (Newfoundland hard biscuit softened and boiled with salt codfish), bread and butter, coffee. Dinner: salmon trout, fruit, chocolate.

In addition to the large quantities of the bedrock staple provisions, there is a long list of odd and often amusing supplies that would never be thought of except by those who had already had polar experience. Yet for the mere problem of existence in those regions, to the experienced one the essentials are few, rifle and ammunition, matches, knife, hatchet, needles.

In my work another special class of supplies

came in, that is, articles for my Eskimos; tools, weapons, implements, etc., for pay and gifts.

Many details so numerous as to be almost impossible to remember develop in connection with polar supplies as the result of experience in various expeditions. The packing of all provisions is of the utmost importance. The first requisite is that everything must be in water-tight packages, as an insurance against damage or deterioration if the expedition is a long one, and particularly as a safeguard against damage and spoiling in case of injury to the ship or in emergency transportation in boats or across the ice under conditions which may mean the repeated immersion of the supplies in sea-water.

Another fundamental essential is that all provisions must be in packages not to exceed a certain maximum weight, which can be readily handled by one man in loading or unloading a ship or boats or sledges, particularly in an emergency, where rapid work is essential.

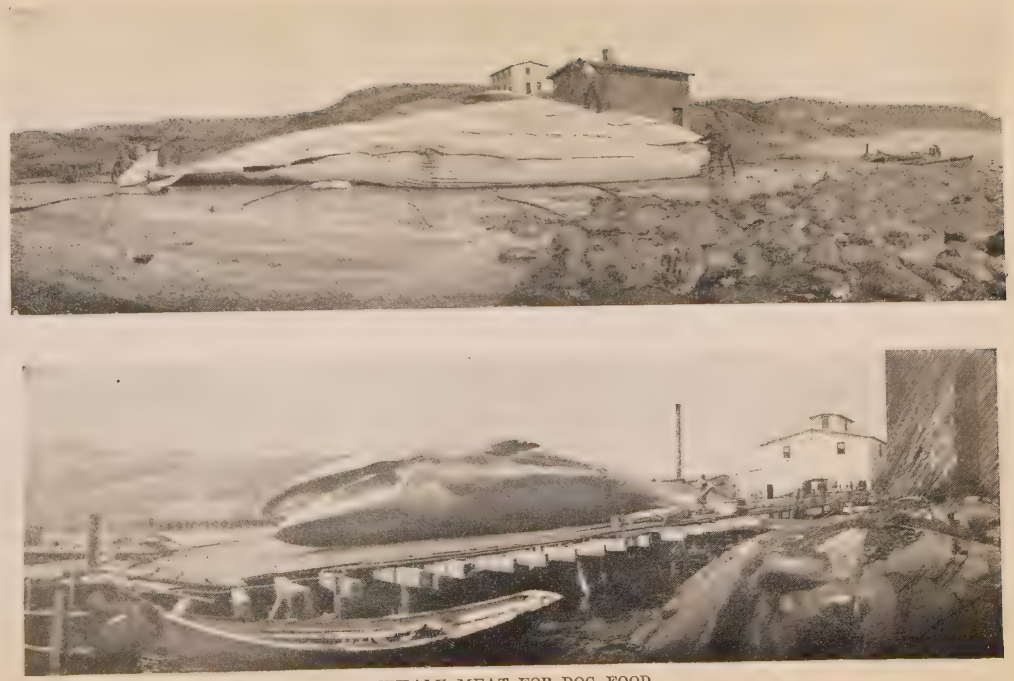
My standard net weight for every package of all provisions which were not particularly ship provisions was fifty pounds. The water-tight tins and the light box or crate outside of the tin made the gross weight of packages from sixty-two or sixty-three to a maximum of seventy-five pounds. Packages of this size can be easily picked up and passed up from the hold of a ship by one man, or can be tossed over the rail to the

ice in case of the crushing of the ship, and they are easily and rapidly handled by one man in stowing in a boat or in taking out of a boat.

Another detail of packing provisions which, as far as I know, was unique and peculiar to my expeditions, was making the depth and width of all boxes containing provisions the same, and letting the length vary in accordance with the specific gravity of the particular item of supplies. To illustrate: All boxes of oatmeal, corn-meal, rice, tea, coffee, sugar, etc., were about twelve inches wide by ten inches deep, and of a length that would just contain fifty pounds of the particular article. Of course a sugar box would be shorter than an oatmeal or corn-meal box, and a corn-meal box would be shorter than a box of tea.

The reason for this standardizing of two dimensions of the boxes was to fit them to be utilized for constructing houses, being laid up like blocks of granite, and breaking joints in the same way. By this method the supplies landed from the ship at headquarters could easily be formed into two or three comfortable houses for shelter of the members of the expedition in case the ship should be crushed or burned.

These houses were built by forming four walls of the boxes of supplies, with the tops of the boxes inside; then putting boards or sails across the top, and banking the whole structure in with snow. When supplies of any kind were re-



WHALE MEAT FOR DOG FOOD

quired, the cover of a box in the wall of the house would be removed from the inside, the tin containing the supplies removed, the empty box then becoming a sort of shelf or locker for other articles, if needed. The main point, however, was that all the supplies could be used, and the house still remain intact.

This method was also valuable wherever large caches of supplies were made at particular points, as the supplies formed at once a strong, comfortable, and rapidly constructed shelter for the use of parties traveling that route and camping at the cache.

Another special point was the marking of all special supplies, such as tea, coffee, sugar, milk, ship's biscuit, which might be called the emergency supplies, on every side with a dash of paint in such a way that any one, whether able to read or write or not (or an Eskimo), if able to see one side of a box, would know at once its contents. This method of marking was the result of the experiences of some expeditions previous to mine in which much time was lost hunting for and endeavoring to identify supplies.

This method also worked for instant efficiency in case of emergency, as a man could seize a case of sugar or coffee to throw over the ship's side or out of a crushed boat without any false motions.

All these points were worked out rather carefully, and in my opinion are so valuable that they

never should be omitted in preparing the supplies of a polar expedition.

Material for equipment of my expeditions (lumber for sledges, webbing for dog harnesses, furs for clothing, tin for making utensils, etc.) was always taken in bulk and in the rough, partly for economy in space, partly for economy in cost, and largely to give occupation to members of the party during the long winter night in making the finished articles.

It can readily be seen that in stowing the ship for the northern voyage, oak and hickory boards for sledges would stow much more compactly than the sledge itself, and be less subject to injury. So, too, with sheets of tin as compared with utensils made from the tin. With furs the same, for made up into clothing they would require double the space taken up by bales.

This method as regards sledge material is particularly valuable during the upward voyage, when, as happened much of the time, the ship was sometimes delayed by the heavy character of the ice, and would have to lie motionless, with banked fires, several days in one place. At such times sledge material was brought on deck, and crew and Eskimos set to work in the best of light, in comfortable temperatures, to make and assemble the sledges. In this way every one was kept occupied and interested instead of loafing and fretting at the delay, and the sledges, as completed,

were in readiness for instant use as soon as we reached winter quarters for the ship. And they were also valuable for an emergency, in the event of the loss of the ship, to transport provisions over the ice to the shore.

The stowing of supplies on board the ship was done in accordance with a plan worked out almost as carefully as would be the builders' plans of the blocks in a granite building, so that every item could be located, and the essential supplies and items of equipment for an emergency—tea, coffee, sugar, ship's biscuit, oil, guns, rifles, ammunition, hatchets, fur clothing—were on top and instantly accessible. When navigating in ice, tea, coffee, sugar, ship's biscuit, and oil were stowed in continuous lines on deck and just inside the bulwarks of the ship throughout the waist, quarter-deck, and on both deck-houses in such a way that one active man could throw a ton of provisions out on the ice in a few minutes. This was in addition to having the whale-boats, as they hung at the davits, stowed and fitted with rifles, shot-guns, ammunition, hatchets, oil-stoves, matches in waterproof packages, together with several days' rations of tea, coffee, sugar, milk, ship's biscuit, and oil.

This was in rather striking contrast to an earlier American expedition, where, it is stated in the official report, nearly the entire cargo had to be overhauled in order to get at some particular item—guns and ammunition, if I remember aright.

Such experiences as this are striking examples and illustrations of what my friend Stefansson has described very effectively in an article entitled "Incompetence as a Literary Asset in Arctic Matters."

In two particular items of supplies my expeditions have been an antithesis of other expeditions. In the case of one item in its absence, in the case of the other in its great abundance. These two items were meat and flour. As a result of my plan from my earliest expedition to depend upon the country itself for my fresh meat supply, I have never carried any of this in the ship's stores. On the other hand, having been most fortunate in my later expeditions, when I had my own ship, in having a steward (Charles Percy) who was a blue-ribboner in making bread and cooking meat, I have carried large quantities of flour. Some idea of the amount of this can be obtained by the fact that in my last north polar expedition, during the eleven months that the *Roosevelt* was lying at Cape Sheridan, Percy baked some 18,000 pounds of bread.

The members of an Arctic party that have fresh meat and fresh bread regularly can never have scurvy, regardless of whether they see a vegetable or a fruit or lime juice from one year's end to another. My work, extending over a period of twenty-three years, during which no symptoms of scurvy ever developed, has shown conclusively

LABRADOR WHALING STEAMER

OFF FOR WHALES—LABRADOR COAST

that white men can remain in the highest latitudes for a period of years with complete immunity from the dreaded scourge.

When it came to the matter of sledge-supplies, even greater care in packing was applied. Pemmican for the dogs was put up in tins just as long as the width of my sledges, so that in a standard sledge-load of dog pemmican the tins formed a continuous flooring to the sledge. The pemmican for the men was put up in tins that were creased in such a way that the block of pemmican, when removed from the tin, was lightly scored in a way that marked it off into one pound cakes, and whoever had the distribution of the pemmican ration at a camp had only to insert a hunting-knife or saw-knife or edge of a hatchet into these marks, and with a blow or two separate the pemmican at once into standard rations.

All these refinements and details may seem amusing to those who have read the accounts of some polar expeditions where such supplies as ship's biscuit or flour or the like were carried in bags, with no protection from moisture or water, and where contact with the sharp edges of ice or the sledge could easily punch a hole through a bag, with a consequent loss of some of the provisions before the mishap was noted.

Some of the same expeditions would get out their scales at each camp and carefully weigh out the various amounts of each item of the rations.

On my polar expeditions my ship's biscuit were all made rectangular in form and sixteen to the pound, so that the matter of adjusting the size of a ration of biscuit was simply the matter of counting a certain number. If it was a full ration,—that is, a pound per man per day,—then the number of biscuit was sixteen. If it was half-ration, eight; a quarter ration, four.

These things may seem trivial to some readers, but every movement and operation which can be eliminated and every minute that can be saved under the trying accompaniments of cold, wind, hunger, and fatigue, which are inevitable in polar travel, make for the conservation of the energy, vitality, and morale of the members of the party.

My last two expeditions carried no food experiments, no wonderful preparations, no condensed products of astonishing powers. I had been through all this in earlier expeditions, and had tried preparation after preparation, only to find them of no value on the serious northern sledge-journey, which was the object and climax of each expedition. For that journey only the four tried articles, pemmican, tea, condensed milk, and hard tack, are necessary, and I could not change or better them for another expedition. On various expeditions I made and tried out several food mixtures, but discarded them all after trial.

In obtaining many of the special items of materials a great deal of time was spent searching through the stores in various places for the particular thing needed.

To obtain a particular size and shape of aluminum dish all in one piece, for a detail of my special alcohol field-stove, I have gone over the entire aluminum stock of New York's great department stores, and then through the catalogues of all the manufacturers, till I found what I wanted or something that could be made to meet my requirements.

Another thing that I recall was steel sledge-shoes. It would seem a simple thing to find in any place that dealt in steel, strips of the metal two inches wide, one-eighth of an inch thick, and fifteen feet long, yet it took me two expeditions to find just what I wanted. The steel for my purpose must be soft enough so that I could drill it in the field, yet hard enough so that the constant use would not too quickly wear it through. Then the edges of the steel must be sharp, like the edges of a skate, so that the sledges would not slew heavily sidewise, with almost certain injury, and so they could be tilted on the edge of one runner, like a skater doing the outer edge, without losing grip on the ice. This is a favorite device of expert Eskimo sledge-drivers in difficult situations. All bar steel in the market had rounded edges, and not

till my last expedition, when I found a cold-sheared steel with edges as sharp as a skate, did I get just the sledge-shoe that I needed.

Then there were the screws for attaching the shoes. The constant pounding to which sledge-shoes are subjected in traversing rough sea-ice soon jars off the heads of any screw that I could find in the market. After a long search I found a tough wire nail of the right diameter, which, by cutting to the necessary length, gave me what I wanted.

As a matter not of conscientious scruples, but of judgment and taste, I am neither a drinker nor a smoker, and I have always selected men for my parties who used neither tobacco nor spirits. Liquor should have no place in a polar ration either for camp or field. Yet on special occasions, as on Thanksgiving, Christmas, and birthdays, nothing gives more zest or helps to lift the day out of the even monotony of the days on each side than a glass of grog or light wine.

The liquor supply of my expeditions has always included brandy and whisky and a little wine. Neither was ever a part of the regular ration, and yet no party was ever sent out without brandy or whisky in its equipment. Brandy or whisky is a medicine as much as salts or calomel, and should be regarded and utilized as such despite the shrieks of fanatics.

If it were possible to obtain strong hot tea or

DUNHAM SNOW SHOES

The center pair of shoes, five feet long, one foot wide, with raised toe and ski curve in middle, is the best shoe made

ITEMS OF SLEDGE RATIONS

Left to right: Compressed tea, condensed milk, pemmican, oil, alcohol, dog pemmican, and ship biscuit

coffee instantly on a sledge-journey in extreme low temperatures, there would be little use for spirits. But when every drop of water must be melted from ice at temperatures of minus sixty degrees or lower, and then raised to the boiling point, it takes time. And when a member of the party has seriously injured himself or has fallen in the icy water, something is needed on the instant to brace his system and keep him from too serious a reaction until a snow igloo can be built to shelter him.

Tobacco is equally or more objectionable in polar work. It affects the wind endurance of a man, particularly in low temperatures, adds an extra and entirely unnecessary article to the outfit, vitiates the atmosphere of tent or igloo, and, when the supply gives out, renders the user a nuisance to himself and those about him.

Of all the items which go to make up the list of supplies for a polar expedition, the one which ranks first in importance is pemmican. It is also the one which starts the most instant interrogation from the average person. I usually find that the character of this absolutely indispensable food is most quickly grasped if I describe it as a dry mince-meat.

Pemmican is understood to be of Indian origin, originally made of the meat and fat of the buffalo, and its name, from the Cree language, means ground meat and grease. It is said that in the

days when buffalo herds were numerous the Indians and half-breeds made large quantities of pemmican in the autumn hunting, cutting the buffalo meat in long, thin strips, which were dried in the sun and wind, then, mixed with buffalo fat, were pounded into a mass.

Too much cannot be said of the importance of pemmican to a polar expedition. It is an absolute sine qua non. Without it a sledge-party cannot compact its supplies within a limit of weight to make a serious polar journey successful. Perhaps I should modify that by saying to make a north polar journey possible, as the conditions in the north are such as to make a successful journey in that region a severer test of refinement in methods and supplies and equipment than anywhere else. With pemmican, the most serious sledge-journey can be undertaken and carried to a successful issue in the absence of all other foods.

Of all foods that I am acquainted with, pemmican is the only one that, under appropriate conditions, a man can eat twice a day for three hundred and sixty-five days in a year and have the last mouthful taste as good as the first. And it is the most satisfying food I know. I recall innumerable marches in bitter temperatures when men and dogs had been worked to the limit and I reached the place for camp feeling as if I could eat my weight of anything. When the pemmican ration was dealt out, and I saw my little half-pound lump,

about as large as the bottom third of an ordinary drinking-glass, I have often felt a sullen rage that life should contain such situations. By the time I had finished the last morsel I would not have walked round the completed igloo for anything or everything that the St. Regis, the Blackstone, or the Palace Hotel could have put before me.

Even the Eskimo dogs were at times obliged to yield to the filling qualities of pemmican, and anything that will stay the appetite of a healthy Eskimo dog must possess some body. I recall an instance where my powerful king dog discovered a tin of pemmican that had had a hole punched in it in some way. The maddening smell of the luscious beef fat through the hole spurred him to drive his iron jaws through the tin until he had ripped it like a can-opener and reached the contents. Had the tin contained ordinary meat, the twelve pounds would have been merely an appetizer for him; but when I found him later, he had voluntarily quit, with only a portion of the pemmican eaten. And—though this may not be believed by others who have had experience with Eskimo dogs—he would eat nothing more that day.

Pemmican is the *only* food for dogs on a serious polar sledge journey; and there is nothing as good as walrus meat to keep dogs in good condition during the autumn and winter at headquarters previous to the sledge journey. I found a

special brand of bacon which I obtained in hundred-pound cases one of the best substitutes for the walrus meat.

On my last expedition as an insurance against lack of time or poor luck in walrus hunting, I took on board several tons of whale meat in bulk at one of the Labrador whaling stations.

Future polar explorers may find this whale meat a convenient and economical source of supply for their winter dog food.

The whale meat should be packed at the station in tins containing fifty to one hundred pounds each. These tins should be filled with fresh sweet meat from whales just killed, and each tin should be filled solid under the constant supervision of a representative of the expedition.

In my various expeditions I have naturally had some experiences with pemmican. In my first two journeys my pemmican supply was part of the pemmican made for the Greely relief expedition. A large amount of pemmican was made for this party; but as the few survivors of the unfortunate Greely expedition were rescued at Cape Sabine and brought home in a few weeks, virtually none of it was used. On the return of the rescue party this pemmican was bought in at auction by a dealer in such supplies, and my outfit was obtained from him. This pemmican was more satisfactory than any I have ever had since. Nine-tenths of it was just as good as when made, and

the fact that occasional tins of it were bad was no drawback and caused me no loss, as such tins were accepted by the dogs at their face value.

The one objection to this pemmican, in the extreme refinement of space and weight demanded for the sledge-journey across the central polar ocean, was that it was put up in round tins.

When this supply was exhausted, I had some pemmican made for me; but it was not entirely satisfactory, and on a still later expedition I was persuaded to purchase some so-called pemmican of a foreign make. This, after I had sailed and it was too late to remedy the error, I found to be largely composed of pea-flour. While nourishing and more or less satisfactory to the men of the party, it was of essentially no value whatever for the dogs, and the work of the expedition was just cut in half by the impossibility of keeping the dogs in first-class condition to do hard work.

Later on I was consoled to a certain extent for this mistake on learning that a foreign expedition, in having its pemmican prepared, had very carefully extracted all fat from the preparation, with the consequent loss of heat-producing qualities, which was quickly discovered in the field under the stress of serious work.

In my last expeditions my pemmican was made specially by American firms, and specially packed for my particular requirements. Its composition, as ordered, was as follows: two-thirds lean beef,

dried until friable, then ground fine, and mixed with one-third beef fat, a little sugar, and a few raisins. Of course no one but the makers knew how much cat, dog, mule, and horse meat masqueraded in the pemmican under the guise of beef; but it all went, and in the case of the dog pemmican, of course, it made no difference. In my 1905–06 expedition the makers, however, in a business-like and perhaps legitimate effort to make the meat go as far as possible, made liberal use of bone meal in the dog pemmican. The effect of this upon the dogs was exactly like feeding a boiler with coal fifty per cent. of which is slate and dirt, and the work obtained from them was just about in proportion to the work that would be obtained from boilers in these circumstances.

In my last expedition a more careful inspection and insistence on edible substances in the dog pemmican remedied this trouble. A portion of the pemmican, however, contained an ingredient which was not at all in the original specifications, and which I should strongly advise against in the pemmican of future expeditions, that is, broken glass. Fortunately, none of my party experienced any ill effects from this, owing to the fact that we still retained the civilized habit of chewing our food, and detected the presence of the glass before it was swallowed. A number of sudden and unaccountable deaths of my dogs, however, we attributed directly to this cause.

Pemmican made of the materials and in the proportions required by my specifications is, in my opinion, as nearly perfect for the purpose for which it is intended as it is possible to make it. I do not believe that it can be improved upon, and I feel that experiments or changes in it are likely to be dangerous to the success of an expedition.

As an illustration of this a subsequent expedition, feeling that the pemmican would be improved in taste by the addition of some seasoning, ordered the addition of salt to the other ingredients, and as a result when it was used continuously in the field the Eskimo dogs, unaccustomed to salt in any form whatever, sickened and some of them died.

Next to insistent, minute, personal attention to the building of his ship the Polar explorer should give his personal, constant, and insistent attention to the making of his pemmican, and should know that every batch of it packed for him is made of the proper material in the proper proportion and in accordance with his specifications.

CHAPTER IV

ICE NAVIGATION

ON July 6,[1] 1908, a black, rakish-looking steamer moved slowly up the East River, New York, beside a puffing tug. Seen broadside on, this craft was as trim and rakish as a yacht; seen end on, the impression given was of the breadth of beam and solidity of a battle-ship.

A sailor, glimpsing any feature of this vessel,—the slender, raking pole-masts; the big, elliptical smoke-stack; the sharply inclined stem; the overhanging stern; the sheer of the bows; the barrel at the mast-head,—would have noted its peculiarity, and looked the vessel over with great interest; and yet she did not look a "freak" ship. As she passed along, whistles on each shore vied with one another in clamorous salutations, and passing craft, from the little power-boat to the big

[1] The sixth of the month is a date of rather special interest to the writer. To begin with, it is his birthday. Then it is the day on which the *Roosevelt* steamed north on the successful quest for the pole; the day on which the pole was reached, and the day on which the wireless message of success was flashed over the world from the bleak Labrador station. Later it was the day on which the writer was made *grand officier* of the Legion of Honor by the President of France, the day on which he began his efforts for air preparedness for this country, and the day (ninth anniversary of discovery of the pole) on which this country, by the President's signature, formally entered the greatest of all wars.

BEGINNING THE NORTH POLE VOYAGE
The "Roosevelt" steaming up East River, N. Y., July 6, 1908

Sound steamer, dipped flags and shrieked a greeting.

With glasses one could make out on a pennant flying from the masthead, *Roosevelt.* The Stars and Stripes at the stern were fluttering up and down incessantly, and the white jets of steam from her whistle were continuous in answer to the salutes.

This was the arctic ice-fighter *Roosevelt,* as sturdy and aggressive as her namesake, built on American plans, by American labor, of American material, and then on her way to secure the North Pole as an American trophy.

At Oyster Bay the ship was inspected and given God-speed by President Roosevelt, then steamed out through Long Island Sound, to Sydney, Cape Breton, for her cargo of coal, then through the Gulf of St. Lawrence, up the Labrador coast, through Davis Strait, across Melville Bay, and between the arctic Pillars of Hercules, Cape Alexander and Cape Isabella, to the battle-ground and the fight for which she was built—the conquest of the contracted channels filled with massive, moving ice which form the American gateway to the polar ocean.

The design of the *Roosevelt* was based upon twenty years of actual experience afloat and ashore in the very region where she was to be used. I had reversed all previous practice in regard to polar ships, and had made this one a pow-

erful steamer with auxiliary sail power instead of a sailing-ship with auxiliary steam-power. I had seen her keel fashioned and laid, I had seen her ribs grow in place, I had seen them clothed with planks, the steel-clad stem and stern shape themselves, had seen every timber put into place and every bolt driven. I felt that I had beneath my feet a magnificent tool and fighting machine that would put me within striking distance of the pole.

Innumerable conversations during a number of years with all kinds of intelligent, well-read people have shown me conclusively that outside of the scientist, the geographer, and those who have made a study of polar exploration, the average person has no idea whatever of the real character of polar ice.

Perhaps the most general impression—I shall not call it idea, because it is not definite enough for that—is that the ice of the polar ocean is a smooth, even, permanent surface, and that the terrible cold of that region was the principal reason why it was not traversed long ago. Others think that this ice is snow-covered, and still others are far enough advanced to think of it as rough, hummocky, or even ragged, but yet as fixed as land itself.

Ideas as to the thickness of the ice are equally wrong, varying from a few feet to a conception of the entire polar ocean as solid. Most people

take it for granted that the ice has been formed by the freezing of the ocean water.

The character of ice varies in different portions of the polar regions. North of Spitzbergen and Franz-Josef-Land and the long stretches of the Siberian coasts there may be even in midwinter miles of ice of a few inches or a foot or two in thickness. This, however, the navigator of a ship rarely sees, as it has either been broken up by the wind or melted by the sun before the season of navigation begins.

In Melville Bay and the channels of the North American archipelago, like Lancaster Sound and Jones Sound and their western extensions, ice forms early in the autumn and continues to increase in thickness through the winter until it reaches a thickness of six or eight feet or, in the fresher waters near the coast of North America, nine feet in thickness.

Some of this ice, with the advent of summer, slowly melts in place and disappears. Most of it, however, gradually decreases in thickness as spring progresses, becomes perforated with holes where the warmer and fresher water from the melting snow on its surface bores through, and then moves off in great fields sometimes miles across.

Ice of this kind, encountered in July or August, presents about the simplest form of ice-

work. Two or three well-directed blows at full speed by a ship like the *Roosevelt* will often start a crack across a field a mile or more wide through which the ship can slowly crowd her way. Or continuous ramming will result in progress, from half to a full ship's length being gained at a blow.

Such ice presents no menace at any time to a ship like the *Roosevelt,* as it cannot crush her, and is simply irritating because of the slow progress it causes and the persistent way in which it drags along the ship's side. In ice like this the monotony is often relieved by the cry of "Nannook!" (bear), from the masthead, and the resulting scurry over the ice in pursuit of the animal.

North of Greenland and Grant Land, from their northern shores to the pole, the character of the ice of the polar ocean is entirely different. In my final journey to the pole less than one-tenth of the ice traversed was ice formed by the freezing of the ocean surface, and more than nine-tenths was fresh-water ice, great fields, some of them of astonishing thickness, broken off from the low, undulating glaciers of northern Grant Land and Greenland, and the "glacial fringe" which skirts all those northern coasts.

The thickness of ice varied from half an inch to an inch on cracks and narrow lanes a few yards wide that had just frozen over, to floes drawing one hundred and twenty feet of water, and with hummocks thirty feet above water-level.

During the winter this mass of ice is for the most part quiet, except that at the spring-tides of every month cracks and narrow lanes form, and then freeze rapidly again. Violent wind-storms will cause some disturbance in the ice, the pressure against the hummocks and ragged pinnacles of the large fields causing them to crush any thin ice before them and throw it up in ridges, thus leaving lanes or pools of open water behind, and causing a slow grinding, twisting motion of the pack, which, however, stops, and the open water freezes over, with the cessation of the wind.

In June, July, August, September, October, and November the mass of ice becomes separated into its various parts, and while no water may be visible, the fields and cakes of ice are simply in contact, not frozen together. Then the spring-tides cause much greater motion, and a violent storm will set the whole mass driving before it, with the big floes wheeling and smashing everything in their course until the storm ceases or the movement is stopped by contact with land. Wide lanes and large areas of open water form, and do not freeze over, and the whole ocean is similar to a river in which the ice breaking up in the spring is moving.

This is the time when the ice pours into all the southward-leading channels; that is, between Franz-Josef-Land and Spitzbergen, between Spitzbergen and Iceland, between Iceland and

Greenland, and down the American gateway between Greenland and Grant Land.

In none of these places is ice navigation a more serious proposition than in the last. With the exception of brief and infrequent periods when the combination of a fresh southwesterly wind and ebb-tide pushes a fan of open water or loosely drifting ice-cakes out from the northern entrance to this channel between Cape Sheridan and Cape Brevoort, the ice is constantly moving rapidly southward through this outlet. When strong northerly winds combine with spring-flood tides, it rushes through with a violence that is startling.

Entering the widely flaring funnel between Cape Joseph Henry and Cape Stanton, then the narrower one between Cape Sheridan and Repulse Harbor, the ice is compressed between the iron cliffs of Cape Beechey and Polaris Promontory (less than eleven miles), while the swift current of this deep gorge does not permit it to stop, and despite a slight overflow into Newman Bay, is forced sometimes a hundred feet up the cliffs by the resistless momentum and pressure from behind. In mid-channel the pressure forces the ice to rafter, or ride, one field over the other, or the edges of the floes crumble as they come together, and pile up the huge ice-blocks in long ridges fifty or seventy-five feet high. Many of the ice-cakes are forced far under water. One who has seen a big drive of logs which filled the banks of a rapid

river pile up and plunge under and ride over when some narrow rock gorge is reached can get a crude idea.

Once through this gorge, Lady Franklin Bay and Peterman Fiord give the ice a chance to expand, and a ship may find here in Hall Basin some open water. Then the walls narrow again between Cape Defosse and Cape Bryant, and farther south the passage is obstructed by Franklin Island and Cape Constitution, till the main channel is less than ten miles wide, before opening out into the wide expanse of Kane Basin, only to be constricted again between Cape Sabine and Cairn Point to a width of twenty-two miles.

When working north in these channels, the only sure way much of the time is to hug the shore, taking advantage of every sheltering point and shallow bit of water, crowding on all steam and forcing ahead a few miles on the ebb-tide, then making fast with all the lines and holding on desperately during the flood-tide, with the ice spinning past only a few feet from the ship's side. Occasionally courage and judgment give a fifty or hundred mile run in mid-channel, but at its end a firm shore-hold is necessary to prevent being set back by the ever southward rush of the ice, and losing all the hard-earned miles.

A kind of ice navigation that may be encountered by polar ships returning from a voyage late in the season is the tough, leathery, newly form-

ing young ice. A fortunate experience and apprenticeship in the whaler *Eagle,* in a very late and unusual voyage in 1886, gave me some knowledge of this, which proved invaluable in later years, and on the expedition of 1905–06 kept me from being held in the arctic a year longer with the crippled *Roosevelt.* For nearly twenty-four hours on the *Eagle* voyage, her crew, rushing back and forth across her deck timed by Captain Jackman or me, rolled her from side to side, while her engines, going at full speed, slowly drove her out of the clutch of the young ice in Cumberland Sound. A day later, and we probably would not have escaped.

In 1906, when at last, late in September, the battered *Roosevelt* forced her way out of the heavy ice some miles north of Cairn Point, young ice several inches thick extended all the way to Littleton Island. This ice was just a little too thick for the *Roosevelt* to steam through, but by rolling her, as we had rolled the *Eagle* years before, she moved slowly through it. A little later an easterly breeze sprang up, and, with all sails set, these heeled the *Roosevelt* to just the right angle to have her lee bow turn the ice under her in a steady stream, and she walked along to open water without a hitch.

At this season of the year a returning ship should never stop in a deep bay, should, if possi-

DRYING SAILS ON THE "ROOSEVELT" AT CAPE SHERIDAN

SHEAR-POLES FOR HANDLING THE "ROOSEVELT'S" INJURED RUDDER

ble, not get caught over night in loose ice, and should always have full steam up.

The key to all polar work is ice navigation. It has made possible the attainment of the north and south poles and the solution of many other mysteries of the surrounding regions which have baffled scientists for hundreds of years. It is ice navigation which puts an expedition where it can do its work, puts it within striking distance of its objective, and without this key the knowledge which the world now has of polar conditions and geography would be comparatively little.

The history of ice navigation dates back to the latter part of the fifteenth century, when for the first time the arctic circle was penetrated by Sebastian Cabot. What ice navigation was in the earliest days it is almost impossible to imagine, though some of the old chronicles give here and there a glimpse of it, and the narrative of Barents's voyage helps us to form an idea. It is no wonder that in the little craft of those days the terrors of the ice to first adventurers loomed as terrible as the horrors of our childhood ghost-stories.

With the growth of the whale fisheries in Baffin and Hudson Bays, the navigation of the ice by the Scottish and American sailors in the first whalers, square-rigged sailing-ships, became a science, and the way in which those ships were worked through

tortuous leads under sail was almost unhuman, if some of the stories are believed. With a strong breeze, these ships could even at times do a bit of ramming, backing their sails to give them sternway, and then squaring them forward to go ahead. But when there was no wind, then they were often laboriously "tracked" by their crews walking along the ice; that is, towed along like canal-boats with a tow-rope. At other times a small anchor would be carried out ahead as far as the longest hawser on board, hooked in a hole cut in the ice, and the ship slowly warped up to it by working the windlass.

When the ice was in small pieces, the crew would get out with long poles and push piece after piece behind the vessel, enabling her to move slowly ahead. Often, however, hours and even days of laborious work would be set at naught by a shift of the wind or a movement of the ice setting the ship back for miles.

This use of poles to push the ice aside was the custom even up to very recent times. I recall how the *Windward,* in August, 1898, coming out of Etah Harbor, was obliged to force her way through a stream of ice two or three miles in width. The engine power of the *Windward* was pronouncedly weak, and we were obliged to resort to this method to get the ice out of the way, so that she might strike feeble blows at the firmer cakes.

I also remember distinctly the feelings with

which I watched the *Hope*, a more powerful ship, less than a mile north of us, moving steadily along through ice of the same character, finally emerging into the open water on the outside of the stream, and disappearing from sight to the south before the *Windward* was completely through.

The introduction of steam revolutionized polar navigation as it did all other kinds, though the first attempt to utilize it in the *Victory* was a rank failure. To whalers fitted with engines as well as sails, voyages, which before were a gamble, now became a regular certainty, and fishing-grounds were sought and utilized that before were absolutely impossible.

Without steam the conquest of the south polar regions would have been impossible despite Weddell's surprising voyage in the early thirties. Without steam the Northwest Passage and the Northeast Passage might still be unnegotiated, and without steam the north pole would still be undiscovered.

As late as the fifties and sixties the ships of Kane and Hayes were propelled by sails alone. Hall in the seventies was the first American to have a steam vessel.

With the construction of the powerful *Roosevelt,* built not only for avoiding ice pressure, but for forcing her way through it and, when necessary, smashing it with powerful blows, ice navigation became a gladiatorial contest, a royal sport,

with the *Roosevelt's* steel-clad bow as cæstus and her fifteen hundred tons of displacement to drive it home.

There is probably no place where ice navigation is so hazardous as in the Smith Sound, or American, route to the pole, where the heaviest of ice, swift currents, narrow channels, and iron shores make the pressures sudden, erratic, almost continuous, and of great intensity. The negotiation of the three hundred and fifty miles of virtually solid ice of all conceivable shapes and sizes that lie between Etah and Cape Sheridan presents problems and difficulties, which will test the experience and nerve of the ablest navigator, and the powers of the strongest vessel that man can build. The value of detailed experience in such strenuous work cannot be too strongly accentuated. In my earlier expeditions I have traveled the shores of these channels anywhere from three to eight times, and know every foot of the coast from Payer Harbor in Ellesmere Land to Cape Joseph Henry on the Grant Land shore, and the ice conditions to be encountered. It was my minute familiarity with the tides of these regions, the small bays or indentations which would afford shelter to a ship, as well as the places which grounding icebergs would make impracticable and dangerous, together with the ice experience and determination of Captain Bartlett, that made it possible four times for the *Roosevelt* successfully

Scotch "Aurora"

Italian "Stella Polare"

Norwegian "Fram"

German "Gauss"

American "Roosevelt"

British "Discovery"

COMPARATIVE PICTURES OF VARIOUS EXPLORING SHIPS

RIVERSIDE

to navigate these channels, a feat which was long regarded as utterly impossible.

The earliest voyages into polar waters were made almost solely in the interests of commerce—to discover, if possible, a short route to China and the East Indies. Keen and costly was the rivalry among the various European nations, and many daring and hardy navigators were sent out by Great Britain, Holland, Russia, Germany, Norway, Sweden, and France.

In 1588, John Davis, following the coast of Greenland from Cape Farewell to Sanderson Hope, a distance of eight hundred miles, gained for Great Britain the record of farthest north, 72° 12′.

Hudson in 1607 broke this record by reaching 80° 23′ N. Lat., and on his return reported the discovery of large numbers of whales and walruses. As a result the arctic circle became the Mecca for the next two centuries for hundreds of whaling-ships and thousands of men from Northern countries.

In 1773, almost one hundred and seventy-five years later, Hudson's record was surpassed by the small margin of twenty-five miles by Phipps, and this new record was not bettered until 1806, when Scoresby, an enterprising British whaler, ventured to deviate from the beaten track of the whalers and reached 81° 30′ N. Lat.

Several attempts were made by Parry to find

the Northwest Passage, and although he was unsuccessful in this, the experience gained in icework was most valuable and marked a new era in polar exploration. He was the first to suggest the idea of a journey afoot from a land base to the North Pole.

After Parry came Ross, and later Franklin; but it was not until 1850–55 that the Northwest Passage was accomplished by McClure on foot. McClure traversed the ice between his ship, the *Investigator,* which had entered the polar ocean via Bering Strait, and was crushed by the ice in Barrow Strait, and Collinson's ship, the *Enterprise,* in Melville Sound, and returned to England via Lancaster Sound and Davis Strait. The actual navigation of the Northwest Passage was effected by Roald Amundsen, who in 1903–06 sailed from the Atlantic to the Pacific in the *Gjoa.*

Subsequently arctic navigators turned their attention to the attainment of the North Pole, and in 1853–55 for the first time in America took a part in ice navigation. Kane discovered and explored the shores of Kane Basin, and outlined a route to the pole, which is now known as the American route.

Hayes, who had accompanied Kane, undertook a later expedition, but did not materially extend Kane's work.

In 1871, Hall, another American, forced his ship, the *Polaris,* to a new northing of 82° 11′.

Four years later Nares in the *Alert* attained 83° 20′ N. Lat. These two ships were the only ones up to this time which had successfully negotiated the channels forming the American gateway to the pole.

All previous records for ice navigation in the arctic regions of the Western Hemisphere were broken by the *Roosevelt,* which reached Cape Sheridan in 1905, and penetrated two miles beyond it in 1908. One ship only has been nearer the pole, the *Fram,* but this higher latitude was attained not under stress of her own power, but by drifting in the grip of the ice.

A glance at the history of north polar exploration will show that it is studded with crushed and foundering ships.

Barents, in 1594–95, lost his ship and his life, his crew barely escaping. Following him came Bering, whose vessels were wrecked, causing the loss of his life, and much suffering on the part of his men before they reached safety on the coast of Kamchatka. The *Dorothea* of Franklin's expedition in 1818 was badly crushed in the ice; in the expedition of Parry and Lyon in 1823–24 Lyon's vessel was nearly wrecked on two occasions, and Parry's vessel, the *Fury,* was actually lost; Captain Ross who started out in the *Victory* in 1829, was obliged to abandon her. Franklin's two ships, the *Erebus* and *Terror,* were lost. The *Assistance, Pioneer, Intrepid, Resolute, Investi-*

gator, were all lost in the course of the search for the Franklin expedition. The Bremen exploring vessel *Hansa* was wrecked (1860–70), and the crew forced to take to the drift ice and later to their boats. Hall's ship, the *Polaris,* in 1872 was caught in and drifted with the ice, nearly destroyed in a violent gale off Northumberland Island, and later grounded. In 1874, Payer and Weyprecht, leaders of the Austrian expedition which discovered Franz-Josef-Land, were obliged to abandon their ship, and with their crew, in four small boats, struggled with the ice-pack for three months before they reached the open sea on their way to safety. In 1879 the *Jeannette,* under the command of DeLong, was caught in the ice, and two years later was crushed and sunk, a number of the party, including DeLong himself, losing their lives.

Some of these disasters have been the result of inexperience, others have been due to the disregard of the first principles of ice navigation, and still others are directly attributable to the utter unfitness of the ship for ice-work. Striking examples of the latter were the *Jeannette* and *Polaris.* These ships, because of their build, should never have gone into the ice. Wall-sided as they were, once caught between opposing fields of ice there was no escape for them, as their shape made it utterly impossible for them to rise and escape the deadly pressure.

ICE NAVIGATION BEFORE THE ADVENT OF POWERFUL STEAMERS

THE "ROOSEVELT" BESET IN WRANGEL BAY

The difficulties of ice navigation increase with higher latitude. Any vessel navigating in polar waters may at any time be crushed so suddenly that nothing below can be saved. At Etah I have always made preparations for such an emergency, and had all the pemmican, tea, coffee, biscuits, sugar, oil, ammunition,—in fact, all the essentials necessary to sustain life and health,—placed on deck close to the rail, where it could easily be thrown off to the ice. In addition to this, the whale-boats, fully equipped for a week or ten-days' voyage, were ready at a moment's notice to be lowered. Each boat, beside the required complement of oars, oar-locks, boat-hooks, a liquid compass, and a bailer, contained pemmican, conveniently packed in six-pound tins; biscuits, fifty pounds; coffee, ten pounds; compressed tea, five pounds; sugar, ten pounds; condensed milk, ten cans; salt; oil, five gallons; a small oil-stove; one rifle and one hundred cartridges; one shot-gun and fifty shells; one box of matches in a tightly-corked bottle; one hatchet; knives; a can-opener; needles, and thread; and medical supplies consisting of quinine, astringent, bandages, cotton, gauze, boracic acid, dusting powder, needles, catgut, and liniment. And every member of the party, including the Eskimos, had a small bundle of extra clothing packed, and stood ready to leave the ship immediately after throwing off the supplies and lowering the boats.

The heavy pack-ice which surges down Smith Sound past Littleton Island usually makes it almost impossible to follow the coast of Greenland northward, and on leaving Etah it is necessary to cross to Cape Sabine, on the Ellesmere Land side.

As a rule, the trip from Etah to Cape Sabine presents no particular difficulty to a ship like the *Roosevelt,* and it may at times be made in continuous open water.

From Cape Sabine the most practical course lies along the west shore, where at ebb-tide a navigable lane of water is often to be found between the shore ice and the moving pack. In 1905, after leaving Cape Sabine and working northward along the west shore past Bache Peninsula and Hayes Point, we were forced to seek shelter in Maury Bay to avoid the heavy ice advancing swiftly before a stiff northerly wind. By keeping a close watch on the ice and availing ourselves of every opportunity to advance, we followed the shore-line up past Scoresby Bay and Richardson Bay. Two attempts to reach Cape Joseph Goode failed, each time the *Roosevelt* being driven back to Cape Wilkes by the ice-pack. Rawlings Bay was packed with ice, and conditions to the northward, on the Grinnell Land side, altogether so unfavorable, that I determined to cross Kennedy Channel and proceed northward on the Greenland side, previous experience in this re-

gion having led me to believe that in most seasons Kennedy and Robeson channels could be more easily traversed on the Greenland side than on the Grinnell Land side.

After a long, hard struggle we reached the loose ice off Cape Calhoun, and headed north from Crozier and Franklin islands. Finding the channel which lies between Franklin Island and Cape Constitution impracticable, we followed the main channel close to Franklin Island.

As far as Joe Island it was fairly easy sailing as polar navigation goes. Making the *Roosevelt* fast to the ice-foot here, a trip to the summit of the island showed the Greenland side of Hall Basin as far as Cape Lupton, and possibly up to Cape Sumner, free from ice, while the Grinnell Land coast was filled with heavy ice, making navigation out of the question. Just beyond Cape Lupton, while breaking a way through a small gap in the ice, a quick change in the current, which runs very swiftly in this deep and narrow channel, forced the ice-floes together about the *Roosevelt,* smashing her up against and along the ice-foot. In less time than it takes to describe, it twisted the back of her rudder, snapped her tiller-rods, almost put her steering-gear out of commission permanently, and necessitated a stop of several days at Newman Bay to make repairs.

We had hoped that a lead across Robeson Channel to the neighborhood of Cape Union would

make the return to the west side of the channel comparatively easy, but in this we were disappointed.

In 1908 the route of the *Roosevelt* from Cape Etah to Sabine and up the west coast of Kane Basin, past Victoria Head, was virtually the same as in 1905. This year, however, we found Kennedy Channel almost free from ice, and with no fog to delay, the *Roosevelt* steamed her way up the center of it, and broke all previous records by navigating the channel's one hundred miles of length in one day.

Before reaching Robeson Channel we encountered ice and fog, and were once driven over to the east coast at Thank God Harbor in an attempt to find an opening in the pack. With this exception the Grinnell Land and Grant Land coasts of the channels were found practicable from Cape Sabine to Cape Sheridan.

On the return voyage from Cape Sheridan to Etah in 1908 I determined to try out a new route in these narrow and ice-filled channels. Instead of hugging the shore, the *Roosevelt,* on reaching Cape Union, was deliberately driven out into the pack-ice in order to work her way down the center of Robeson and Kennedy Channels. For a ship not specially built for ice-work such a course would be almost certain to result in disaster, but for one of the *Roosevelt* type, and in the hands of experienced ice-navigators, I consider this by

far the preferable return route. It is also the quickest route, the trip from Cape Sheridan to Cape Sabine taking only twenty-three days, or twenty-three days less time than by the old route in 1906.

The navigation of polar waters demands incessant watchfulness and instant readiness even under apparently the most favorable conditions. During the passage of Kennedy and Robeson Channels Bartlett was nearly always in the crow's-nest, and while I had almost unbounded faith in his judgment, I spent much of the time in the rigging below the crow's-nest, watching the ice ahead, and in the worst places often relieving Bartlett of too great a load of responsibility by backing up his judgment with my own views. The periods of night at such times might as well not have been, for it is possible to get only snatches of sleep in the short times when nothing else remains to be done, and Bartlett and I have spent days and even weeks at a time in these regions without thinking of taking our clothes off to sleep.

The chief engineer, like his assistants, stood his eight- or twelve-hour watch, and was almost always to be found in the engine-room when the *Roosevelt* was passing through dangerous places; for any slip in the machinery at a critical time would have resulted in the loss of the ship.

The *Roosevelt* has undoubtedly deliberately struck heavier blows while fighting ice than any

other ship would dare to attempt. Many times she has reared and risen on a steel blue mass of old floe-ice till I was reminded of a hunter rising to a stone wall. Repeated blows of her steel stem in the same spot have at times split pieces of floes, or the projecting tongue of a big floe which barred our passage, of almost incredible thickness just as a small hand ice-pick, if properly used, will split a large cake of ice.

In loose ice or in one season's ice or in any kind of ice in the open sea a ship like the *Roosevelt* may be regarded as immune.

Really serious conditions are those met in threading a way through a succession of big floes of heavy ice in contracted channels where the tides run rapidly, and where the impingement of one floe against an unyielding headland may cause a jam extending for miles, the floes coming together like the cars of a long freight train in a head-on collision.

Under these conditions the movements of the floes are watched with hawk eyes, and if it is seen that the ship is going to be caught between two of the fields, she is made fast in a concavity in the edge of one floe or the other, with a point of ice ahead and astern to take the brunt of the pressure. Then, if there is time and the floes are very heavy, the crew go out onto the ice with pick-axes and bevel down the edge of the floe against the ship's side to assist her in rising.

This beveling of the edge of the ice next to the ship's side was always done when the *Roosevelt* was made fast against the face of the ice-foot in an exposed position. Sometimes charges of dynamite in line a few yards away from the ship will shatter the edge of the floe and form a cushion of smaller pieces for the ship to be forced against.

With skill and good judgment it is often possible to drive the ship into a sheltered pool where three floes coming together form a deadlock, expending their force against each other while the ship lies in a little ice-locked pool of water as in a natural harbor. Sometimes this harbor opens with change of the tide. Often it grows smaller and smaller till it disappears; but time is thus given to make the ship secure, and sometimes, by placing dynamite to smash off a corner and having full steam on to jump the ship through before the floes close again, escape is effected.

The *Roosevelt's* most serious times were at the northern entrance to Kennedy Channel, where at the neck of the funnel there is a grinding hell of great ice-fields crowding one another on the rush of the spring-tides in their eagerness to get south. A memorable instance was her thirty-five-hour battle across the channel from Cape Sumner to Wrangel Bay August, 1905, a distance of *fifteen* miles.

Two crucial situations are when, with the unbroken face of a big floe on one side, the point or

corner of another on the other side catches the ship. In this situation, if the ship does not rise, she is lost. The other is when a big field, with the weight and pressure of miles of ice behind it, comes slowly rotating along the shore with resistless force. Every effort should be made to get outside of such a floe. If this is impossible, then the ship should be driven into a niche of the ice-foot, if possible in the lee of some stream delta, made fast with every line, and the edge of the ice-foot abreast of the ship beveled down as low as possible to facilitate the ship's rising on it.

The *Roosevelt* had two or three very close calls of this kind on her upward voyages, the ice pressing up over the ice-foot and piling up on the cliffs a few hundred yards ahead or astern of her. I recall one instance where with the glasses I saw from the crow's-nest huge ice-blocks climb fifty feet up the cliffs at a point a mile or so ahead of us at the very place where some hours earlier I had thought of making the *Roosevelt* fast to await the turn of the tide. Fortunately I had decided to take no chances, and had retreated a mile or so to a safer position.

There is one phenomenon in this region which is certain to cause the leader of an expedition temporary palpitation of the heart the first time it occurs. When the ice-floes come together, and the edges crush and pile up in great ridges of ice-blocks, other pieces of ice are forced down, and

THE "ROOSEVELT" STEAMING THROUGH THE ICE-PACK

FLOE IN LADY FRANKLIN BAY THAT LIFTED THE "ROOSEVELT" NEARLY CLEAR OF WATER

in the deeper portions of Kennedy Channel large granite-like blocks are held down undoubtedly one hundred or more feet below the water. When the ice pressure relaxes, these start for the surface, gathering momentum, as they rise, and leap half their bigness above water, then settle back.

Two or three times blocks of this kind on their way up struck the bottom of the *Roosevelt* a resounding thump just as she was released from the strain of ice pressure and had settled back into the water. The shock is different from the tense vibrations of ice pressure or the crash of butting ice at full speed, or the grinding crunch of running on a rock. It is an upward shock as from the blow of a great hammer, that jars every timber in the ship. Its first occurrence usually forces the involuntary exclamation, "My God! what has happened now?" After the first time, one is always ready for it, and so is not disturbed.

No attempt should ever be made to anchor in this kind of navigation unless one wishes to present the ice deities with his anchor and much or all of his cable.

Just as sure as the anchor is put down a big floe will come along and squat on it; then there is nothing to do but unshackle your cable and let it go. It cost me two anchors and two cables one summer's trip to learn this lesson thoroughly. On another voyage in a usually safe position a big floe compelled me to drop an anchor and all of

its cable, though I recovered it the next season.

Whenever the ship is to be made fast, it should be done with lines and hawsers made fast to ice pinnacles, holes in the ice, or ice anchors.

It is well also to bring the end of line or hawser on board, so that it can be cast loose without sending a man off the ship. Movements of ship and ice are sometimes too rapid to risk a man.

To a ship built as sturdily as the *Roosevelt,* with no greater speed and with a lively helm, icebergs are no bugbear. During the upward voyage it is continuous daylight, so that even in thick weather there should be no difficulty, with ordinary care, in detecting the proximity of bergs along the Labrador coast and in Greenland waters in time to avoid them. North of Kane Basin real icebergs are rarely seen, and these only small ones. In the polar ocean there is nothing that can be dignified by the name. On the return voyage, in the long, dark nights and short, dull days of late autumn, in Melville Bay, Davis Straits, and along the Labrador coast, they compel a careful lookout. With all lights shut off, a reliable man way forward, and two officers on the bridge, we never had serious trouble even in the darkest nights in detecting the "loom" of a berg in time to shift the wheel and avoid it. "Growlers"—that is, translucent fragments of bergs as hard as granite, of the same color as the water, and just barely floating—are the kind of

ice that succeeds most completely in rendering itself invisible. My ships have bumped these more than once in brilliantly clear weather, with no other ice in sight and the lookout gone below.

I recall coming home across Melville Bay in one of my earlier auxiliary ships. It was a brilliant moonlit September night, not a piece of ice in sight anywhere, a fresh following breeze, and the ship making about ten knots. It was the mate's watch, and the other officers and members of the expedition were below in the cabin when suddenly there was a terrific bump. The ship seemed to stop completely for an instant; then, after a vicious lurch or two, went on her way. Every one in the cabin except the captain went in a mess against the bottom of the forward bulkhead. The captain, sitting on the after locker, was nearly cut in two against the cabin table, and went about for a day or two like a man who had been kicked below the belt by an army mule. We had made a bull's-eye shot at what appeared to be the only growler in the bay. Of course these growlers are not a source of danger to a ship like the *Roosevelt,* though they would be to a weaker ship.

I have thought, if I should go north again, that I would try a search-light for the autumn return voyage. In thick fog, of course, such a light would be of little or no use.

A trick that is sometimes of considerable value in squeezing through the ice is to use the ship as

a big pinch bar to separate two cakes of ice. With the stem forced into the crack between the cakes, the engines are driven ahead full speed and the wheel thrown hard over alternately to port and starboard. In this way the bows are gradually forced farther and farther in until the ice has been pried apart, and the ship squeezes through.

Streams of ice in the open sea are a pronounced comfort in heavy weather. If the ship is on the lee side, she can steam along in smooth water, with the wind blowing a howling gale, the ice acting as a breakwater. If she is on the weather side, a ship like the *Roosevelt* can force her way into the pack and lie in comfort. This is often a distinct help with a deeply loaded ship on the upward voyage.

In the one season's ice of Melville Bay a ship may often force her way through mile after mile by continuous repeated blows like a drill or well-borer, smashing the ice into small pieces for some feet or yards at every blow. But once past Cape Sabine there is no more of this. Then it needs skill as well as power, and progress is a matter of dodging, turning, squeezing, twisting, rushing along a narrow lane of water and striking sledge-hammer blows at points or masses of blue granite; then, when further progress is absolutely impossible, banking fires to save coal and waiting for the next round.

THE "ROOSEVELT" LASHED TO THE ICE FOOT

IN THE CROW'S-NEST

It needs incessant watching of every move of an enemy with a myriad tricks and resources, and then instant decision,—"pep," as my young friend Borup would have put it,—and a little courage.

In all my experiences I recall nothing more exciting than the thrill, the crash, the shock of hurling the *Roosevelt,* a fifteen-hundred-ton battering-ram, at the ice to smash a way through; or the tension of the moments when, caught in the resistless grip of two great ice-fields, I have stood on the bridge and seen the deck amidships bulge upward and the rigging slacken with the compression of the sides; or have listened to the crackling fusillade of reports, like an infantry engagement, from the hold, and felt the quivering of the whole ship like a mighty bowstring, till she leaped upward, free of the death-jaws, and the ice in snarling turmoil met beneath her keel and expended its fury upon itself.

Again I can see Bartlett up in the crow's-nest, at the head of the swaying mast, jumping up and down like a mad man, swearing, shouting to the ship, exhorting it like a coach with his man in the ring. Ah, the vibrating bigness of it! How fine it would seem to be at it again!

CHAPTER V

WINTER QUARTERS

THE matter of winter quarters is one of pronounced importance to polar travelers, ranking second only to the question of an abundant supply of food. Warmth, dryness, and abundance of light are the great desiderata. A knowledge of Eskimo methods of house-building, combined with a little ingenuity, enables these needs to be secured with few and simple materials.

In an experience extending over twenty-three years I have had occasion to prepare winter quarters afloat and ashore for parties of from three up. Many ideas were tried out, and most of them discarded as useless. Some were found of value, and utilizing these, I have introduced on different expeditions, and have tried out with most gratifying results, a new design for winter quarters the general principles of which I believe will be of value to future explorers in these regions. After I had had opportunities to study Eskimo principles and methods of house-building I gained new points, and could easily have adopted their practice *in toto*. With the addition of some materials

of civilization, it was possible, however, to improve upon their results. Now, given a tent, a pickax, and a shovel, a bale of pressed hay, a lamp, a few gallons of oil, and the wood of the cases in which my provisions were packed, I could make a winter habitation for from two to six men in which they would be just as comfortable as at home.

If the Eskimos, with their crude intelligence and almost utter lack of materials, can construct comfortable habitations to protect them and their children through the bitter, months-long winter night, surely the white man, with his superior intelligence and limitless range of material, should be able to do as well.

Headquarters for my expedition of 1891–93 were established in McCormick Bay, where I was sure of securing an abundance of fresh meat for my party of seven. The site for our winter home was selected only after most careful consideration. It was essential that it be on land high enough to insure dryness; that it be sheltered from strong winds, and yet get as much sunlight as possible. It should also be free from danger of snow or rock slides and from spring floods, and not too far from the shore.

A grassy knoll on the southern shore of the bay about a hundred feet from the water's-edge was finally decided upon as meeting most fully our requirements. A brook on each side made a good

water-supply certain. A hundred feet back of the house were brown cliffs, which had the disadvantage of cutting off the sun in the early spring and late autumn; but they served as a protection against the winds, and we felt this was the best we could do.

All material for the house was of course taken north with us, and on the way up was cut and fitted, ready to nail together and set up at once upon our arrival.

Red Cliff House, when finally completed, was a sort of house within a house, there being an inner frame that was separated from an outer frame by an air space ranging from ten inches on the sides to something over three feet in the middle of the roof. A sheathing of closely joined boards and two layers of tarred paper on the outside of the outer framework made it air-tight, while the inner house was made of heavy boards, and rendered air-tight by a coating of heavy brown paper.

The interior was twenty-one feet long, twelve feet wide, and eight feet high, and was divided into two rooms. A wall was constructed all the way around the house, leaving a passageway of four feet between. For the lower portion of this wall, empty barrels, stones, and turf were used, while wooden boxes containing canned supplies, piled in regular courses on top of this foundation,

COMPLETE POLAR WINTER HOUSE
Before banking in with snow

A SCENE AT HUBBARDVILLE 82° 30′ N. LAT.
One of the box houses in winter

formed the upper portion of the wall. I had the supply boxes made the same width and depth, but of different lengths, specially for this purpose. A roof of canvas extending from the house to the wall made a closed-in corridor, which we used as a storeroom. The boxes were stacked so that the covers could be opened from the inside, making their contents as easily accessible as if they were on pantry-shelves. This corridor was quite large enough to serve as a workroom, and here we made our sledges and other equipment necessary for sledge-journeys. When the snow came, a long snow entrance to the corridor was constructed; the roof was covered with a thick blanket of it, and the walls were banked, still further to protect us from the wintry blasts.

For our stove a pit was dug in the ground, so that the fire-box came below the level of the floor, thus insuring the warmth of air even down to the floor level, and lessening the danger of fire. To carry the stovepipe out so that it would not come into contact with the woodwork, we ran it through a double window the glass of which had been replaced with sheets of tin. Air-shafts were suitably arranged for carrying off moisture and bad air.

This done, heavy Indian blankets of bright red, adding warmth and color to the interior, were used to cover the walls and ceiling; bunks were

built along the wall; and with a few chairs and a table, a library, and our cooking-utensils, our home was ready for occupancy.

My expedition of 1893–95 had its headquarters at the head of Bowdoin Bay a few miles north of Red Cliff. Our home here was to accommodate a party of fourteen, just twice as many as were housed at Red Cliff, and consequently had to be made much larger than our first winter home. Anniversary Lodge, as this later came to be called, was built on the same general plan as Red Cliff House, with an inner air-tight shell separated from an outer air-tight shell by an air space from one to three feet in width. The roof was almost flat, and a closed-in corridor ranging from four to six feet in width, and with a nearly flat roof, surrounded the whole building. The outer wall of this was likewise made of boxes filled with supplies, and a covering of snow was used to protect it from winter weather. The floor was double, tongued and grooved, and lined with tarred paper. The inner and outer sheathing were also tongued and grooved, the former lined with blankets and felt, the latter covered inside and outside with tarred paper. The outer joints were covered with battens.

The house was divided into four rooms, the central part of it, fourteen feet long, nine feet wide, and eight feet high being partitioned off to serve as kitchen and dining-room while two end rooms

opening from it were used for sleeping-quarters.

A window three feet high extended across the entire front of the main part of the house, and each sleeping-room had a window, protected by a storm-window, with an overhead sash to prolong the arctic day as long as possible. During the arctic night this sash was covered with hay. In addition to this a sky-light was built in the roof to catch the last rays of the departing sun, and during the winter it was covered with hay and a blanket of snow.

During the winter of 1894–95 my party was reduced to three members, including myself, and the winter quarters was modified to meet our requirements.

The central room was selected for our use. The partition between the kitchen and the dining-room was taken down, and a small stove set up in the middle of the forward part of the room. The stovepipe was carried out through one of the ventilator-shafts, and carefully wrapped in asbestos to prevent its burning the woodwork. The table was cut down to one-half its original size to meet our needs, and a wide bench extending the whole width of the room was built under the windows. Covered with a large bearskin, it was used as a seat in the daytime, and at night I slept on it.

The other two members of my party slept in the rear of the room. A platform was built three feet from the floor, with a distance of six feet be-

tween it and the back wall. Two cots were placed with their heads resting on the platform and their feet supported by cleats nailed to the rear wall. This arrangement is similar to the Eskimo method, giving the occupants a good circulation of air as well as lifting them out of the low temperature and drafts near the floor. These beds as well as my own were fitted with blanket curtains. Shelves were built under the bed platform and near the stove to hold our current supplies of coffee, flour, etc., and the space back of them was utilized for storage purposes.

A closet for dishes and books and another for medicines were built on the east wall of the room, while along the west side was our gun-rack, containing shot-guns, repeaters, carbines, and a Daly three-barrel gun. A clock, chronometers, barometers, barograph, etc., were hung above the gun-rack. A bird-net was suspended from the ceiling for drying out grass, which we used in the bottom of our *kamiks,* and three barrel-hoops were placed about the stovepipe at the top of the room for drying our stockings, *kamiks,* mittens, and other articles of clothing.

The walls and ceiling of the room were decorated with magazine pictures, which not only covered the cracks, but made the room brighter and more cheerful. A large ten-gallon can served as a water-tank, and a pail for our coal and a mo-

lasses-keg chair completed the furniture of our living- and sleeping-room.

In the west room we kept our furs, clothing, and part of our equipment, while the east room was used for a general storeroom and workroom. In one end of it was our coal-bin, a barrel of sugar, and one of biscuit. The room was heated by a small stove, was furnished with a table and Eskimo lamp and a wide bench covered with skins, which served as a seat for our Eskimo seamstresses, who made all our fur clothing in this room. Our sledges and tent also were constructed here, and walrus meat was cut up and packed for the sledge-trips, so that the room was usually full of happy, noisy natives.

Most of the wall surrounding the house had been emptied of supplies during the previous year, and the empty boxes and barrels used for fuel. Now we had to find a new way to protect our room from the cold. Finally we dried thoroughly all our baled hay, and filled the spaces between the inner and outer framework of the house with it. We also reinforced the wall between our living-room and the east room by a wall of hay two and a half feet in thickness from the floor clear to the ceiling, finishing it with a small vestibule with double doors. The wall between our room and the west room we packed with furs. Outside protection was secured by placing four

large biscuit-casks along the side of the house under the windows of our room. Their tops came even with the window-sills, and hay was packed in the spaces between them and the house. When the snow came, everything was banked in snow three or four feet deep, a wall of snow-blocks was built along the east side of the house, a snow entrance erected, and we were snugly housed for the long winter night.

In these expeditions I gained a fairly thorough knowledge of Eskimo methods and principles of house-building, and it may not be amiss to give here my description from "Northward Over the Great Ice" of their winter igloos:

> These igloos vary in size, from nine to fourteen feet in length inside, and occasionally two, more rarely three, are built close together, the party wall doing double duty and thus economizing material and labor. In plan and method of construction, each igloo is built like all the others. There is a long, low, narrow stone tunnel; a small standing room; a shallow platformed alcove on either side for meat and the stone lamps; and a large platformed alcove in the rear,—the family bed. A single small window of seal intestines over the entrance admits a little light.
>
> The construction of one of these primitive habitations, half excavated beneath, half built above the surface, would seem at first glance to demand nothing beyond a considerable outlay of manual labor in transporting and arranging the stones. Yet the spanning of a space twelve by fourteen feet in such a way as to support a heavy load of stones, turf, and snow, is not an entirely simple problem in a country where there is literally not a splinter of wood or anything that can serve as a substitute for it. Yet these children of the ice have met and

solved this problem with the cantilever principle, and the roofs of these old stone houses are every one supported with massive stone cantilevers, firm and unyielding as a masonry arch. In the plan and arrangement of his house, too, the Eskimo has met and solved each problem that confronted him, and though the entrance is never closed, yet no draught or current of air disturbs the quiet interior, the thick non-conducting walls of stone and turf are perfect insulators from the savage cold, and the heat from every drop of the precious oil burned in the stone lamps is fully conserved. Many of these igloos have every appearance of being centuries old. Vertebrae of the now extinct whale are almost invariably built into their walls and frequently such enormous stones are used in supporting the roofs, that it seems impossible they could have been handled without mechanical appliances.

All the roof and bed platform stones, which must be large, flat and thin, as well as many of those for the walls, had to be brought by the men on their backs from the mountains, sometimes a distance of several miles. The construction of the igloos falls very largely upon the women, and in an emergency they even assist in bringing stones.

These stone dwellings are occupied from the latter part of September till April or May, depending upon the season, locality, and movements of the occupants. By May they usually become very damp, and then the family betakes itself to its tupik, removing, at its departure from the igloo, the windows and a portion of the roof, so that throughout the summer the sun and wind may have free access to the interior. There is no ownership of these igloos beyond the period of actual occupancy. Any one of them is free to each and all, and it is the exception rather than the rule that a family lives in the same igloo, or in fact in the same place, two years in succession. . . . The building of a new igloo is rather a rarity, also, and is necessary only when, for some special reason, an unusually large number of natives are attracted to one place. Usually no more families locate in a place than the existing igloos will shelter.

A temporary form of habitation used by the Eskimos at the spring walrus hunt at Cape Chalon, and sometimes when a death in winter drives a family out of the permanent habitation, is constructed of snow, lined, in the case of the more-well-to-do Eskimos, with their skin *tupiks*, or tents.

These igloos are for use only for a few weeks. The Whale Sound Eskimos do not, like the Baffin Land tribes, use snow houses for their permanent winter habitations. The following is a description of one of these:

> It was twelve feet long, by twelve feet wide, and seven feet high, in the highest part beneath the sealskin lining. The bed-platform, raised a foot and a half above the floor, was six and a half feet deep; and the standing room in front of it six feet by five feet. The window of seal intestines was two feet square. The igloo was lined throughout with the tupik or summer tent, so arranged as to leave an air space between it and the snow walls of the igloo, thus preventing the latter from melting, and keeping the interior dry. A small hole in the highest part of this lining, and another directly over it in the top of the igloo, afforded ventilation.

A long, low, narrow snow tunnel gave access to the igloo, and protected the interior from drafts or penetration by the furious spring storms.

A still more temporary form is the small, rapidly constructed snow igloo used by traveling parties in winter and spring, and occupied only for a single night unless the travelers are held by

AFTER A WINTER BLIZZARD
"Roosevelt" surrounded by chaos of shattered and upheaved ice

UNLOADING SHIP AT WINTER QUARTERS
The "Roosevelt" at Cape Sheridan

storms. This is the kind of igloo invariably used by my parties on their sledging-trips.

The Eskimos can nearly always tell who built an igloo. Though they are all constructed on one general principle, there are always peculiarities of individual workmanship which are readily recognized by these experienced children of the North, whose horizon is so narrow that they see and remember every minute trifle.

The fundamental principle of all these houses is that warm air is lighter than cold and rises. The level of the bed and living-platform in an Eskimo igloo is always higher than the highest part of the entrance opening. In the best of the permanent winter igloos the entrance is through the floor. As a result of this construction, every bit of warm air is retained in the igloo, and the long and—whenever practicable—downward-sloping entrance tunnel prevents even the most violent air-waves of furious blizzards from penetrating the quiet interior. The vertical variations in temperature in the winter igloo of a successful hunter who has good store of blubber to keep the stove-lamps going are pronounced. On the bed platform, at the level of the lamps, the host and hostess and children are usually in their birthday suits, unless the lady, in deference to the presence of a guest, assumes a strip of seal-skin half an inch wide. If one stands, bringing

the head to the top of the igloo, it is like putting one's head into a furnace. Yet a drop of water spilled on the floor of the igloo, a foot below the level of the bed platform, is instantly frozen into ice.

On several subsequent expeditions my parties wintered on board ship, and this introduced new elements. The first thing to be done by any well-managed polar expedition on reaching winter quarters is to land everything in the way of supplies and equipment and fuel, and to erect suitable shelter for the entire party ashore as a precaution against fire or other mishap to the ship. The ship should, in fact, be emptied completely.

My first practical working out of this proposition was with the *Windward* at Cape D'Urville in the winter of 1898–99. The boxes of supplies landed here were erected into a compact house, with a box-tunnel entrance, fitted with a small stove, and banked in completely with gravel, which in winter of course became covered with snow, giving the appearance of a snow-drift. This house, in addition to serving as insurance for the party during 1898 and 1899 in case of the loss of the *Windward,* lying unprotected in the ice offshore, was during the three following years a welcome haven and refuge for my parties sledging from Etah and Payer Harbor to Fort Conger.

This box-house idea was greatly extended and

developed in my last two expeditions of 1905–06 and 1908–09 in the *Roosevelt*.

At Cape Sheridan, the winter quarters for these last two expeditions, we built box houses ashore, using the boxes containing supplies just as we did in previous years, and packing them in firmly with hay. The packing of our supplies for this purpose in boxes of certain sizes was one of the many details which determined the success of the expedition. The heavy cases of bacon, pemmican, flour, etc., were used as so many blocks in the construction of several houses about thirty feet long and fifteen feet wide. For roofs, sails thrown over boat-spars or beams were used, and later were covered in solid with snow. A stove set up in these made good workrooms for the Eskimos through the winter. On the last trip north, when the *Roosevelt* was caught in the grip of the ice, the Eskimos became so thoroughly frightened that they picked up their belongings and took to the box houses for the night, some of them spending the rest of the winter in them or in snow igloos.

The adjacent shore for a quarter of a mile was lined with the remaining boxes of supplies, each item of provisions having a pile to itself. This packing-box village was called Hubbardville.

Had we lost the *Roosevelt* at Cape Sheridan, we should have spent the winter in the box houses

which we constructed, and in the spring should have made the dash for the pole just the same. We should have then walked the 350 miles to Cape Sabine, crossed the Smith Sound ice to Etah, and waited for a ship.

The second new element introduced into my later expeditions by the presence of a ship was the preparation of the ship itself for winter quarters.

A partial beginning at this was made on the *Windward,* where my own personal quarters were an Erie Railroad caboose given to me by my friend Eben Thomas, president of that road. This caboose I put on the deck of the *Windward* between the mainmast and foremast, and bolted it down like any deck-house. In the autumn at Cape D'Urville, when the temperatures began to go down seriously, I had my Eskimos incase and cover it in with a wall of snow-blocks, and build a beehive-shaped vestibule or storm entrance of snow-blocks round the door.

This arrangement, in its comfort, facility of ventilation, freedom from the moisture and condensation incident to the quarters of the others below decks and the old system of ships' quarters, was so superior that I was convinced the only place for the quarters of a polar ship was on deck.

In building the *Roosevelt* I put the quarters for every one, officers, crew, and Eskimos, on deck, and in the two expeditions of 1905–06 and 1908–09, in wintering at Cape Sheridan, I worked out fully

what I believe to be the most comfortable and satisfactory method of ship's winter quarters.

As a result, the officers and crew of my last two expeditions had light and roomy accommodations on deck, a great improvement over the old method of housing a party below decks, as in all old-fashioned ships, and even in ships built comparatively recently for polar work.

My assistants and the ship's officers were quartered in a deck-house between the mainmast and mizzenmast. The deck-house extended clear across the ship, was low-posted,—seven feet from floor to ceiling,—and contained the cook's galley and domain as well as our quarters. It was plainly and strongly constructed, sheathed inside, and special care was taken, by the use of heavy building paper, double planking, and close joints, to have no cracks or joints for the entrance of cold air.

The journey north in the ship, being a summer coasting voyage, with no danger from high or heavy seas, and the deck-house being above the main structure of the ship, I was able to put in large plate-glass ports along the sides to light the interior; and for the same reason I was able to put real windows—four in all, double and of special heavy glass—in the forward and after end of the deck-house, with generous panes of glass in the upper part of each of the four doors, two forward and two aft, which opened into it.

This arrangement made the quarters immeasurably pleasanter and more sanitary. On the upward voyage we got full value of all the sunlight there was, ventilation was perfect, and from my stateroom I could at all times command the situation; and if I was needed on the bridge, it was only a step through the door to the deck, and two jumps up the ladder to the bridge. The great value of this large window area was in the late autumn and early spring, when it gave us in each case about two weeks more of daylight in our quarters, and shortened by just so much the long period of continuous lamplight. The arrangement was also invaluable for those left on board when the main spring sledge-parties left for their work, and for the sledge-parties themselves in the weeks of waiting after their return in May or June till the ship could break out of her winter quarters in July or August.

My polar experience has made me a fanatic on the subject of light. My little summer cottage on the bluff point of a rocky islet off the Maine coast has so many windows that it is known by the surrounding inhabitants as the "glass house." Sun-worship seems to me the most natural of religions, and I wonder why all primitive peoples were not devotees of it.

My crew and Eskimos were quartered in a long, commodious topgallant forecastle, which ex-

tended from the heel of the bowsprit to well aft of the foremast. This fo'c'sle, like the after deck-house, extended the full width of the ship, and was low posted,—six and a half feet from deck to ceiling,—and also had large ports along the sides, and large windows in the after end, looking out on the main-deck. A fore-and-aft bulkhead its entire length divided it into two equal parts. The starboard side was assigned to the crew and the port side to the Eskimos.

Around the walls of the Eskimo half of the fo'c'sle was built a wide platform, three or four feet above the deck, to simulate the internal arrangement of their usual winter houses. The quarters of each family were partitioned off by boards, and curtains screened the front. They were supplied with oilstoves, pots, pans, plates, etc., and cooked their meat and anything else they wanted, eating when the spirit moved, as is the custom among these people. Beans, hash, or anything of that kind provided from the ship's stores were cooked for them, and they were also supplied with tea, coffee, and bread by the steward.

The winter of 1908–09 the *Roosevelt* lay at Cape Sheridan, parallel to the shore, just over the edge of the ice-foot bank. Her nose pointed north, her port side was next the shore. On that side, between ship and shore, a distance of a hundred yards, was the shallow ice-foot lagoon, covered

with one season's ice. On the starboard side was the heavy polar ice, and a short distance from the ship a depth of twenty fathoms.

The experience of the previous expedition had shown that a severe westerly storm or the grounding of a heavy floe at a point where it would deflect the moving ice against the ship, or a big floe rotating down the shore on the surge of the spring-tides might at any time send a cataract of ice against the *Roosevelt* with a force which, if not deflected, might push the ship high and dry ashore. To assist the ice in turning down and passing under the ship when such pressure came I had the heavy ice cut away round the ship on a bevel toward the ship's sides, with the inner edge in contact with the ship down to or below the water-level.

Small pieces of ice and snow were then banked against the ship's sides up to the deck-level. The object of this was twofold, to help by its weight to turn the ice under the ship when the pressure came, and also to blanket the ship against the winter storms and bitter cold. On top of this embankment a wall or armor-plating of snow-blocks from a foot to eighteen inches thick was built as high as the tops of the deck-houses both forward and aft. The tops of the deck-houses were covered with an equal thickness, and the thwartship ends of the deck-houses protected by similar walls. Entrances to the after deck-house.

AN INOPPORTUNE SNOWSTORM

to the fo'c'sle, and to the Eskimo quarters were guarded by roomy beehive-shaped snow houses, with a small low door opening out upon the deck.

Behind this snow-armor protection against the siege of the frost king, we passed the winter in complete comfort, with a minimum expenditure of fuel, with perfect ventilation, with very little of the moisture and condensation which is usually the bugbear of polar ship's quarters, and with instant and easy access to the outside for work or in an emergency. The snow armor costs nothing; it is found on the spot, and therefore takes no room on the upward voyage, and when it has served its purpose it is thrown overboard.

During the successive expeditions north I also had several other experiences in building winter quarters, some of which may be of interest.

The Erie Railroad caboose mentioned above, which was used as a deck-house on the *Windward* during the winter of 1898–99, served also a second season at Etah. In the summer of 1899, after the *Windward* broke out of the ice at Cape D'Urville, she returned to Etah, and here I had the caboose hoisted over the side, floated ashore, and hauled up to a place which I had selected. From one end of this a long workroom was built with the boxes of provisions, and roofed over with a sail. The Eskimos of my immediate party constructed their winter houses with entrances leading into this common workroom, and the

whole group was then buried deep in snow, forming an entirely comfortable habitation for the entire party.

Another experience was at Payer Harbor. When the remodeled *Windward* went north in 1901 she had a commodious and well-built deck-house forward that had been constructed for quarters for her officers. On my decision to remain north another year, remembering my experience at Etah, I decided to save my party the valuable time and labor incident to constructing winter quarters by utilizing this deck-house. Captain Sam Bartlett and his men lifted it from the deck, lowered it over the side, ran it over the heavy harbor ice on timber shoes, and with tackles and falls hauled it up the rocks to the place that I had selected for it.

Here, after the ship had left, we banked it in completely as high as the bottom of the port-holes with loose dry gravel, which is abundant at Payer Harbor, and when the snow came, covered it completely, roof and all, with an armor of two-foot-thick snow-blocks, carefully laid and cemented together by throwing water on the joints. A double snow igloo, Eskimo style, at the entrance kept out completely the furious winds which howled incessantly past Cape Sabine and Payer Harbor, and we lived here through the winter of 1901–02 in perfect comfort, with a minimum expenditure of fuel.

The third and perhaps most interesting experience was at Fort Conger, the headquarters of the Lady Franklin Bay Expedition. Returning here in June, 1900, from my long sledge-journey round the northern end of Greenland, in which I proved the insularity of that island continent, I waited at Fort Conger through the summer on the possibility that an auxiliary ship might come north and be able to reach me.

When late in the season it became evident that no ship would arrive, I took up the matter of the winter quarters for my small party, consisting, beside myself, of Henson, the doctor, and several Eskimos. The utilization of the building known as Fort Conger was entirely out of the question. This great barn of a structure, sixty feet long by thirty feet wide, was grotesque in its utter unfitness and unsuitableness for polar winter quarters. With its great size, its light construction, and its high-posted rooms, nine or ten feet from floor to ceiling, it embodied about everything that should not be found in winter quarters.

One possibility would have been to construct in the center of one of the great rooms of this building a small room with material taken from other parts of the house, utilizing the big house simply as a wind-break, and constructing the small apartment in the proper way, with double walls, low ceiling, and tight joints.

After some consideration, however, I gave up

this idea, and decided upon three small structures outside of the big house and made partly of material from it. For myself, partly to economize the lumber, partly as a practical experiment, and partly to furnish occupation and amusement for myself, as I still was somewhat incapacitated from taking part in the hunting-trips over the rocks and frozen ground as the result of the accident to my feet the year before, I decided to make for myself a winter den, as perhaps it might be called, from an eight by twelve A tent, which I found among the things at Conger, as a nucleus.

First I made an eight-by-twelve-foot floor of boards resting directly upon a bed of gravel. The idea of air spaces round a polar dwelling as an insulation against the cold is, like many other ideas connected with the polar regions, a pure fallacy. At each corner of this floor I drove a post, sawing it off four feet above the ground, connected the tops of these posts with horizontal joists, boarded up to this joist with odds and ends of old boards, and banked in to the top of this boarding with the surrounding gravel, working in against the boards, as the gravel bank gradually rose, a two-or-three-inch thickness of grass, which grows somewhat abundantly in the neighborhood of Conger.

On top of these joists I erected the tent, putting in a few intermediate rafters on each side of the ridge-pole to prevent the side of the tent from

sagging; fitted a small door-frame and door into one end of the tent; and on the sides two window-frames and windows taken from the big house; then covered the tent completely, roof and gable ends, with the straw-filled mattresses taken from the men's quarters of the big house. A chimney made from a few lengths of vitrified sewer-pipe found in the material at Conger, a stove constructed from a ten-gallon sheet-iron oil tin, one of the cots from the big house, a table, and a chair completed the outfit.

Later, when the snow came, a wall of snow-blocks eighteen inches in thickness was carefully laid, inclosing the entire tent, each course as it was laid being sprinkled with water brought up from the bay, the joints cemented in the same manner, and after all was done, bucketful after bucketful of water dashed over the structure until it was essentially a single block of ice. A low, narrow, covered snow-tunnel entrance, with storm-door at the outer end, gave access to the tent.

In this structure I passed the polar winter at Fort Conger in entire comfort, using for fuel chips, old papers, bits of tarred paper, and the like picked up during the summer about Fort Conger. To give an idea of the complete insulation of this place from the external cold, I found, on returning from some of the autumn hunting-trips, that I could warm the interior of my tent to

a comfortable temperature by the judicious burning of a yard of tar roofing paper in my sheet-iron stove.

Winter quarters should be as warm and comfortable as possible, as a matter of improving the effectiveness of the personnel. In this they play a very important part. Men who have passed the winter in comfort and ample warmth have more vitality and endurance and will stand the strain and exposure of the spring sledge-journey better than men who have been uncomfortable and chilly through the winter. This is just as definite a proposition as that Eskimo dogs that have been well fed during the winter will stand the sledge-journey better than dogs that have been half fed. The ideas of toughening one's self against the cold, of training for the sledge-journey, of inuring one's self to scant rations, are fallacies.

The Eskimos, through generation of life in the polar regions, have worked out from stern experience the true practice in all such life questions, and we find them keeping their winter habitations heated up to the nineties, and we find them gorging themselves with food when food is to be had. As a result, when the necessity arises, they are in condition, and have a reserve vitality which enables them to endure bitter cold and to go for a long time on scant food.

Even the animals, the musk-ox, the reindeer,

the hare, know the trick, and during the summer eat incessantly and travel little, and thus get themselves in condition for the bitter winter when it requires incessant travel to secure starvation rations.

After the question of suitable quarters for a party comes the problem of keeping them in good spirits during the four months of darkness, the secret of which lies in keeping each member busy and in varying the monotony of the work as much as possible. For this purpose much of my material was taken north in the rough, and the work of shaping it—building sledges for our spring work, making harnesses for the dogs, our fur clothing, and other equipment—as well as regular hunting-trips, kept time from hanging heavily on our hands. The younger members of the party invariably went out on hunting-parties during the eight or ten days of moonlight each month, those who went into the field one moon staying on the ship the next. The coming and going of these parties gave plenty to talk about and to look forward to.

As for hedging my men about with rigorous rules, I believe it is not necessary, and have never done it. Much of the routine of ship life was laid aside while we were in winter quarters, there being only the watches of the regular day and night watchmen, the only regular bells being a signal

for all noise to cease at ten in the evening, and another for lights to be turned out at midnight. Meals were served at regular hours in the mess-rooms, and lights were supposed to be out at midnight, but were not forbidden if a man wanted one after that time. For the Eskimos there was one rigid rule—no noise was to be made by them after the ten o'clock bell until eight the next morning. And they knew, if they were up late at night, they would be expected to go on with their work of building sledges and making fur clothing as usual the next day. The engineers and sailors, besides attending to their regular work, sometimes helped with the equipment, but seldom went out on hunting-trips.

I had a fairly complete arctic library in my cabin, and these books were borrowed one at a time by the different members of the expedition. We also had a good collection of the best novels, which did much to while away the long evenings, and a pianola, the gift of a friend, gave us all great pleasure. The sailors amused themselves with games of checkers, dominoes, cards, in story-telling, boxing, and in contests of strength with the Eskimos. A banjo or an accordion was in almost every party, and frequent phonograph concerts in charge of the steward, Percy, varied the monotony. Holidays like Christmas, New Year's, Thanksgiving, and birthdays were ob-

served by a special dinner, with a table-cloth and our best dishes, with perhaps games or sports afterward. On all my expeditions few, if any, complaints of homesickness or monotony were made.

CHAPTER VI

POLAR CLOTHING

THE question of clothing is one of vital importance to the polar explorer, and it is a matter concerning which there is a wide difference of opinion among various authorities. Despite what some explorers say to the contrary, clothing made from the fur of arctic animals is the only kind suitable for serious work in these regions. Many, finding the fur clothing of their own particular expeditions unsatisfactory for the purposes to which they put it, have drawn general instead of specific conclusions in regard to the value of fur.

There have been very few who have appreciated the value of fur clothing. Nansen was one of these, but he was not fortunate enough to be able to get the real polar furs for use, and therefore found his wolf-skins not so satisfactory as he had expected.

Schwatka was about the only arctic traveler of the recent past who appeared to have fully appreciated and to have known how to use fur clothing properly, and he was perhaps the only one who was an outspoken and unequivocal advocate of its value.

British explorers seem to have been specially averse to the use of furs in arctic work, their aversion to this style of clothing being as pronounced as their antipathy to the Eskimo dog for traction power. This may perhaps be due to failure to understand the use of these two essential factors in the successful explorer's work.

Stefansson is one of the most practical of present-day polar explorers, and in an interesting article on "Misconceptions about Life in the Arctic" ("Bulletin American Geographical Society," January, 1913) he has the following to say about clothing:

That fur clothing is not suited for Arctic wear is a thesis of some explorers of high standing. Like many other such beliefs it has its reasons, but to the mind of the present writer there seems to be a flaw in the reasoning. The conclusion of these eminent writers should have been specific rather than general; they should have concluded that such fur clothing as their particular expedition was provided with was unsatisfactory for the particular use to which they put it; they did not have the logical right to condemn fur clothing in general because such as they had, when used as they used it, did not give satisfaction.

Most of the fur clothing to which its wearers have objected is made in temperate lands (such as Norway) by people who are unfamiliar with the conditions to be met by the garments they are making; secondly, there is an art of taking care of fur clothing—that a fur coat rots to pieces on a man's back in a week is really a criticism of the man, not the coat, though the coat usually gets the blame. The whole art is in keeping the garment dry or drying it when it becomes wet. Explorers of standing have said in print that this cannot be done, a conclusion with which I do not believe any man will agree who

has been a member of Peary's expeditions, Amundsen's North-West Passage Expedition or Leffingwell and Mikkelsen's Arctic Expedition, or in fact of any expedition whose members have thought it worth their while to see how the Eskimos take care of their fur clothing.

The writer has had personal experience with "approved fur clothing for Arctic use" made (in Norway, or Lapland, I believe) for Scott's first Antarctic Expedition and the Leffingwell-Mikkelsen Arctic Expedition. I have been told the deerskin clothing of both these expeditions was made under the same auspices; at any rate, it was substantially similar in character. It is easy to understand how an explorer whose experience was confined to such fur clothing should conclude it unsuited to Arctic use—or, indeed, to any use whatever except that of exhibition as curiosities. A description of a typical garment—a coat given me by Captain Mikkelsen—will suffice.

The coat was made of deerskin whose thickness and length of fur leads me to think it was taken from an old male deer during, say, the month of November. The skin was so thick that the coat would almost stand alone on the floor; it was so stiff that when one had it on it took considerable muscular effort to bend the arm to a right angle at the elbow; when one allowed the arms to hang naturally they stuck out from the body approximately at an angle of 35 or 40 degrees. The coat was open in front, from the neck down, some ten or twelve inches and even when buttoned up allowed the wind to blow in; when the garment had once been put on I could not get it off without help, although it was several "sizes" too large for me. On a spring balance (which may indeed not have been accurate), the coat weighed over ten pounds, or about as much as a complete double suit of inner and outer garments of well-made Eskimo fur clothing suitable for any winter weather.

As a contrast to the above "approved" Arctic fur coat, take a coat such as is worn by the Eskimos of the north coast of America. To begin with, Eskimos use the skins of old male caribou only for boot soles or for floor covering in their dwell-

POLAR CLOTHING

Compare the fitness and evident comfort, freedom and convenience of the fur costumes in this picture with the nondescript rigs of artificial fabric used by many north and south polar parties

A "TUG OF WAR" AT 84° N. LAT. AND —55° F.

Note the freedom of motion and complete protection afforded by the fur rig

ings; those for garments are taken in summer, while the hair is short, from young deer—fawns and yearlings preferably. They are scraped into the softness of chamois with stone (or iron) scrapers and sewed into clothes that fit as loosely as our summer suits. The coat is put on after the manner of a sweater and hangs loose everywhere except that its hood fits snugly around the face (over the head, in front of the ears and under the chin). The coat I am wearing this winter weighs 3½ pounds, and I have another (a trifle too light for an outer garment and intended for an undershirt) that weighs 2¾ pounds. My 3½-pound coat is actually a warmer garment than the heavy European coat described above, is soft as velvet and in good condition after six months' wear and nine hundred miles of winter travel. I have seen complete Eskimo winter suits consisting of one pair of socks, one pair of boots, one pair of drawers, one pair of trousers, one undershirt, one coat, two pairs of mittens—all of deerskin—that weigh only 10 pounds in all and yet are warm enough to keep a man comfortable all day in such cold occupations as sitting on a snow block fishing with a hook through a hole in the ice at 40° below zero. Now that deer are getting scarcer on this part of the coast, however, the Eskimos are forced to use skins they would not have considered fit for clothing a few years ago—and still I do not think I have as yet seen a suit that would weigh as much as the combined weight of one coat and one shirt of the "approved Arctic clothing." It goes without saying that the Leffingwell-Mikkelsen Expedition discarded their European clothing as soon as they came in contact with the superior Eskimo garments; the British Antarctic Expedition naturally had to use theirs or fall back on woolens in the unpeopled lands to which they had gone.

As to the suitability of woolens for Arctic wear: There have been few expeditions fitted out with such care in every way as was Roald Amundsen's *Gjoa* Expedition, and the finest woolen coats and underwear I had ever seen were the (Danish?) garments used by them. From my own experience with a coat from that expedition which came into my hands and which I used occasionally during the winter of 1906–07 there is

this to say: I suppose the Scandinavian "vadmal" coat would be as fit for service after three years as a deerskin coat is after one, but the woolen coat is double the weight of an average deerskin one and not more than half as warm. It makes a good coat in calm weather, but the wind penetrates it easily. While it forms a good emergency garment there is little doubt that any future ventures of Capt. Amundsen's will depend chiefly upon garments of the Eskimo type. I have heard that the *Gjoa* had some wolfskin clothing that was quite satisfactory for winter use; this, when well made, doubtless forms a passable substitute for deerskins and is probably even warmer, pound for pound of weight.

I am fully in sympathy with Stefansson's views, and have had the same experience and some of the same nightmare fur clothing that he speaks of so feelingly.

Stefansson's Eskimos, however, make their entire clothing of deerskin, as do the Baffin Land tribes. My Whale Sound Eskimos, either from the greater severity of their seasons, or on account of the greater number of fur-bearing animals, or the scarcity of reindeer, use a greater variety of furs in their costume, and to my mind have evolved a better costume. Bearskin, in particular for trousers and midwinter boots, I consider far superior to deerskin, and I have used both.

After over twenty years of experience, I consider the Whale Sound Eskimo clothing in material, design, and method of wearing the ideal clothing for polar work. With very slight modifications, I have adopted it completely for my parties, and I believe that failure to use it is a de-

liberate waste of the energies of a party, a handicap to its work, and a danger to the members.

My personal outfit on my last journey was as follows:

A skin-tight shirt of the finest quality of thin red flannel, something like a one-piece knit bathing-suit, with a close-fitting hood. This garment covered body, arms, wrists, neck, head, and came down about three inches on the thighs. It protected me from any roughness of the fur clothing and from the unpleasant clammy sensation when occasionally, in heavy going and constant lifting on the sledges, the inside of my fur coat became temporarily moist with perspiration. The warmth of my body kept the flannel shirt always dry. Across the back, over the kidneys, a second thickness of flannel was sewed to protect the kidneys from cold and consequent overaction. There were no buttons, hooks, strings, or fastenings of any kind on this shirt. The above description is more voluminous than the garment, which would readily go into an ordinary trousers pocket.

Bearskin trousers, reaching from the top of the pelvic bone to just below the knee-cap. These trousers were made from the selected skin of a yearling or two-year-old bear with thin, soft, yet tough, leather, and thick, soft, almost wool-like fur. Two pieces, carefully cut to have the grain of the fur running down and the thinner parts to come in the crotch between the legs, make the

trousers. The only seams are up the inside of each leg, and from the middle of the waist in front down through the crotch and up to the middle of the waist in the back. Triangular bits of tanned sealskin at the ends and intersections of seams reinforce against ripping. At the top of the trousers a binding of tanned sealskin incloses a thin, strong rawhide line as a draw-string, by which the trousers are adjusted closely to the wearer's body. The bottom of the legs are made just as small as will allow the feet to go through, and when the trousers are pulled up into place, they fit the leg closely just below the knee. A band of bearskin about two inches wide is sewed round the bottom of each leg, which in very cold, windy weather, in drifting or deep snow, or when the wearer is in danger of getting into the water, is turned down, and the tops of the boots are tied firmly over it to make a tight joint. The trousers are lined with fine, soft red flannel. There are no buttons, hooks, clips, or fastenings of any kind in these trousers, or any openings. The cord at the waist is adjusted to the wearer, and by a contraction of the muscles the trousers can be slid down over the hips to mid-thigh without loosening it.

I consider this garment perfect for polar work. It is impervious to cold,—I do not recall ever being chilly for a moment from waist to knees,—is almost indestructible, gives the wearer perfect

POLAR CLOTHING

Spring and Summer working costume. Sealskin coat, bearskin trousers, sealskin boots

freedom of movement, and possesses the quality, essential in every garment for polar work, of permitting the fine snow driven in by the wind to be beaten out with whip-handle or snow-knife.

A deerskin hooded coat of selected autumn skins of doe or young buck. The front and back of the coat are each cut from a single skin, the front being of lighter weight than the back. The head of the back skin forms the foundation of the hood. The remainder of the skins furnish material for the sleeves, which are cut in a way to bring the thinner parts of the belly skin in the armpits and inner part of the arm.

In length the coat is more a jacket than a coat, the bottom of it coming only a few inches below the top of the bearskin trousers. It is shorter on the hips than in front or back, where it cuts to two rounded points, the one in the back a little longer than the other. In this way the action of the legs in walking, running, snow-shoeing, climbing pressure ridges, or lifting on the sledges is entirely unimpeded. The bottom of the coat must fit closely over the fur of the trousers. Round the bottom of the coat a binding of tanned sealskin, as at the top of the trousers, contains a thin, strong rawhide draw-string. A loop of this projects from the point of the coat behind, and the two ends from the point in front. By passing these ends back between the legs, then through the loop and forward again, the bottom of the coat can

be drawn closely into the fur of the trousers, making a tight joint to keep out driving snow when on the march, or the cold when sleeping. To make this joint still more close, an inch-wide strip of fur was sewed round inside the bottom of the coat, just within the draw-string.

At the wrists the sleeves, which should come fully to the hand, are made just as small as possible and allow the hand to be pushed through them. On the inside a two-inch-wide band of fur, hair inside, is sewed like the packing round a piston-rod, to keep this joint tight when wrist and hands are in motion.

The face-opening in the hood is made just large enough to allow the hood to be pushed back from the head in calm weather. Around this opening is a roll of soft bearskin, with only one edge sewed down. This is partly to protect the face from the wind, partly to serve as a packing, as at the wrists and bottom, to prevent the entrance of cold air or the escape of warm.

Worn ordinarily turned down like a coat-collar, in bitter winds, this bear-skin roll can be turned up like a collar to form a wind-guard for the eyes and face.

In one place—and this is the most essential feature of the coat—it does not fit closely; that is, about the upper arms. Here the sleeves are ample in size, and the armholes are large and cut low, so that by dexterously shifting the coat as

far to one side as possible on the shoulders, first one arm, then the other, can be drawn inside the coat. The practical application of this is invaluable. If in using the whip continuously, or repairing a sledge, the hands become numb from extreme cold or because the mittens are damp, it is easy to draw a hand and arm within the coat, leaving the mitten in the sleeve, place the numbed fingers in the opposite armpit—the warmest part of the body, as every Eskimo knows—until it is thoroughly warmed, then treat the other in the same way.

In camp, after the evening meal of pemmican, hard-tack, and tea has been finished and the day's notes written up, both arms and hands are drawn inside the coat,—leaving the mittens to plug the sleeve openings,—where they may rest by the side or be folded across the chest in warmth and easy position. The coat thus becomes the upper half of a light, well-fitting one-man sleeping-bag, that is warm and dry and permits entire freedom of movement.

This coat has no buttons, hooks, toggles, lacings, or fastenings of any kind, and it gives the maximum of warmth with the minimum of material and weight. As with the bearskin trousers, drifting snow and the frost condensation from the breath can be beaten out of these coats completely.

Deerskin has one disadvantage; if the leather becomes wet and remains so for a day or two, the

fur falls off in patches. The hair is also rather brittle. For this reason and because I was determined on my last expedition to remain in the field till the pole was secured, I fitted each member of my party with a sheepskin coat of the same pattern, details, and trimmings as the deerskin ones, but using tanned sheepskin of the kind known in the trade as shearlings.

Specially soft, perfect skins, light of leather and thick and fine of wool, were selected, and such skins furnish the best substitute for deerskins that I know. They are extremely strong and durable, only slightly affected by being wet, and are nearly as warm and only a little heavier than deerskins. For a late-spring or early-summer journey they are superior to deerskin. They have one disadvantage: snow and the condensation of the breath cannot be beaten out of them like the deerskins.

Hareskin stockings of the thick, soft, fluffy winter pelt of the polar hare, with the fur turned in, with bottoms made of sealskin, as the hareskin is too tender for the heavy wear and strain on this part.

Boots of two kinds. A pair made from the leg skin of the polar bear for the bitter temperature of February and March, and a pair of tanned sealskin for the milder temperatures of April and later. Both were soled, with the rough skin about one-eighth of an inch thick from the back of the oogsook, or square-flipper-seal, both reached

POLAR CLOTHING

Full winter sledging costume. Deerskin coat, bearskin trousers, and deerskin boots. Have worn this rig with comfort at —73½° F.

ESKIMO DOGS

The two nearly white dogs on the left are the type North Greenland Eskimo Dog. This species, direct descendants of the Arctic white wolf, is registered by the American Kennel Club

nearly to the knee, and both had at the top a raw-hide draw-string which permitted their being tied air- and water-tight over the flap at the bottom of the bearskin trousers.

In using this footgear,—which for one who knows how I consider the best there is, and for one who does not know how is nearly useless,—a thick, even pad, or cushion, of the fine, soft, dry arctic grass is arranged in the bottom of the boot, then the stocking is put in very carefully, and a thin layer of the same grass placed in the bottom of the stocking. The object of the first layer of grass is to keep the bottom of the feet warm and to protect them from the sharp corners of the ice. The second inner layer is to take up any moisture from the feet rather than have it absorbed by the fur of the stocking.

The grass sole in the boot should last several days; the one in the stocking may, and perhaps must, be replaced after every march, particularly if the work is hard.

Inner soles of the skin of deer or sheep or bear may be a substitute for the grass, though none is equal to it. The fur inner soles are more easily arranged.

Mittens of both bearskin and deerskin, the former for coldest weather. Both have palm of seal-skin, and when the hand is closed in grasping whip or upstander, rifle or ice lance, it is completely protected by the heavier fur. Inner

mittens of blanketing and a little dry grass are used to absorb the moisture from the hands, and these can be changed after every march. A band of deerskin with fur inside sewed round the wrists over the pulse helps materially in keeping one warm when traveling in extreme cold.

In the same way that immersing the wrists in cold water when overheated will cool one off quickly and safely, so a warm covering for the pulses assists in keeping one warm. The Eskimos are well acquainted with this fact.

Long as has been this description, the entire suit weighs only a few ounces over twelve pounds, essentially the same as the weight of my winter business suit, underwear, etc., for the latitude of Boston or Portland, not including the overcoat.

In such a suit a man, seated or curled up in the lee of an ice hummock, with arms drawn in and face bent on his chest, can weather in comfort a blizzard at –50 F. In a snow house, on scant rations, such a suit will conserve a man's heat and strength equivalent to several days' rations. Such a suit renders a sleeping-bag superfluous, thus allowing its equivalent weight of more pemmican to be carried. On sea ice it is imperative as a matter of safety. In it a man is always ready for instant action, and if the ice-floe splits beneath him while asleep, he can escape.

CHAPTER VII

UTILIZATION OF ESKIMOS AND DOGS

NEXT after the special ship, the most important tool in my campaign of polar work has been the Eskimo, as dog drivers. A fundamental principle of all my work has been the utilization of the Eskimos and dogs. I have used the Eskimos to a greater extent than any other explorer. They have formed the rank and file of my sledging- and hunting-parties, and have built my sledges, dog harnesses, and other equipment; the women have skilfully fashioned the fur clothing, essential for comfort in these regions.

From the very beginning of my polar work I believed that these most northerly human beings in the world could afford me invaluable assistance in my plans for exploration. Later I had a fatalistic feeling that the Almighty had put the little tribe in this particular place for the express purpose of assisting to win the pole.

Using their country as a base for my work, I have lived among and worked with them from 1891 to 1909, a period of eighteen years, during which time I made a thorough study of their language, their mode of living, the food they ate, the

houses they built, and the clothing they wore. I made these people my friends, training them in my methods, and directing the modification and concentration of their own methods in order to make them more useful and valuable in my work. In 1909 there was not a man, woman, or child in the whole tribe between Cape York and Etah that I did not know, as well as their capacity for endurance and work. In my last expedition it was in my power to utilize the entire energy and concentrate the entire resources of the tribe on my work and objects.

In powers of endurance, in ingenuity and intelligence in adapting themselves to their surroundings and in using to advantage every one of the all too few possibilities of their land, they are, in my opinion, unequaled by any other known aboriginal race. With their wonderful knowledge of ice technic and their ability to handle sledges and dogs, the Eskimos were really more necessary as members of individual parties than white men; for although they were not qualified to lead, they could follow another's lead and drive dogs much better than any white man.

Eskimos in the party make it easier for the leader in various ways. A party of Eskimos, sent out to hunt, to scout, or to establish a depot, need only to be told what they are going out for. It is not necessary to go into every detail of how to do it, or to caution them in regard to all the minutiæ

YOUNG ESKIMO MOTHER AND BABY

ESKIMO FAMILY AND "TUPIK," OR SUMMER TENT

of field-work and its dangers, as in the case of a party of white men. All these things they know, and when they have started, the leader may dismiss them from his mind and not worry a minute about them. They will return in good condition. In this way they count very pronouncedly for conservation of the leader's nerve force. If I turned back a party of three or four Eskimos from Cape Hecla or Columbia, or two or three marches out on the ice, to make their way back to Conger or Payer Harbor or Etah, I dismissed them from my mind as soon as they were out of sight, knowing that they would make the trip all right. In the same circumstances, I should have a party of white men on my mind until I saw them again weeks or months later.

The language of the Eskimos is not difficult to acquire, one season spent among them being sufficient to gain a working knowledge of it. It is necessary for explorers to learn it, as the Eskimos have little or no desire to speak English, and consider it far simpler for the white man to speak their language.

One must make a psychological study of these people properly to manage them. They are people of peculiar temperament, very much like children, and should be handled like children, firmly, but gently. They are as easily discouraged as they are elated. For the most part they are good natured, but occasionally indulge in a fit of sulks.

It is no use at all to get vexed at a sulky Eskimo, but one can usually be jollied out of such a mood without difficulty. They greatly appreciate kindness, but are very quick to impose upon a weak or vacillating person. They never forget a broken promise or one that has been kept. In all my dealings with them I have made it a point to mean exactly what I said, and to insist upon things being done according to my instructions. If I promised an Eskimo a certain reward for a task well done, he always got it. If, however, I told him a certain punishment would follow a forbidden course, he knew it would come.

By way of encouraging them to do the things I wanted done and keeping them interested in their work, a record was kept of the game brought in by every Eskimo, and a special prize went to the best hunter. The man who secured the musk-ox with the best set of horns or the deer with the finest antlers got a special reward, as did the man who turned out the best sledge or proved to be the best all-round man on a long sledge-trip. In firmness, tempered with love and gratitude, I have found the best method of dealing with them, and their faithfulness has abundantly attested its efficacy.

Some may get the idea that the Eskimos would serve as faithfully as they did me, almost any one who offered them gifts, but the record of arctic exploration shows that such is not the case. They

have not only known me for almost twenty years, but I have saved whole villages from starvation, and the greatest hope and ambition of the children have been to become hunters or seamstresses who would some day be rewarded by "Pearyaksoah."

As a result of my various sojourns among them, the entire tribe has been raised from the most abject destitution to a condition of relative affluence. Twenty-five years ago they were dependent upon hunting weapons of the most primitive type. There was not a rifle in the whole tribe when I first visited it, and they had only a scant supply of knives, which they had obtained from whalers or exploring ships visiting their shores or caught in the ice near Cape York. In olden times these people improvised knives from the iron of the great Cape York meteorites that I brought home in the summers of 1896 and 1897. Pieces of bone or ivory formed the handles of these knives, and in a groove of the handle small fragments of the meteorite were ingeniously set to form the cutting edge. Very small and crude an instrument it appeared to be, yet it was a great improvement over the bits of flint which in still earlier times had been the only implements the tribe possessed for cutting purposes.

These iron knives had been discarded several generations previous to my first trip north, but in the spring of 1895 I was fortunate enough to run across one of these relics which a woman of the

tribe had unearthed in the interior of an old igloo which she was rebuilding for winter use. A few months later a man discovered the handle of another, and an old Eskimo identified them both, the former as a woman's knife, the latter a man's. They were the only ones of their kind known to any of the tribe.

Twenty-five years ago there were few *kayaks,* or skin canoes, among the Eskimos, and the man who owned a spear-shaft or a harpoon-shaft made of a single piece of wood was well off indeed. There were also many women who had no needle, and had to do all their sewing with the aid of a bone awl. They first made a hole in the garment with this, and then drew the thread through. For thread they used the sinews of the reindeer and narwhal.

Conditions are now different among these people. Instead of lacking every accessory and appliance of civilization, every man and boy owns his canoe; there is an ample supply of cutlery, knives, hatchets, saws, cooking-utensils, and needles. All the men have their own repeating-rifles and breech-loading shot-guns and plenty of ammunition, and every hunter has wood for his sledge, his lance, his harpoon, and his seal spear. As a result of owning better weapons, the condition of the whole tribe has improved. The efficiency of the hunters is double what it used to be, thus insuring a more abundant food-supply and

DECK SCENE ON THE "ROOSEVELT" (NOT A PINK TEA)

SOME OF MY HUNTERS

better clothing. Warmly clad and well fed, they can meet more easily with hardships which are their daily lot.

I have a sincere interest in and affection for these children of the North, and have tried to help and instruct them to cope more effectively with their inhospitable surroundings and to avoid weakening their confidence in themselves and their content with their lot in life. How to care for themselves, how to treat simple diseases, wounds, and other accidents, are some of the fundamentals which I have attempted to instil in their minds. In exchange for dogs, skins, or other supplies necessary for my work, or as rewards for service rendered, I have always given them the very best articles and material which could be bought.

Gustav Olsen, a Danish missionary at North Star Bay, Northern Greenland, in his report to the State Department of Denmark in 1910 made the following statement in regard to the improved conditions of the Eskimos:

> The Eskimos here, both his companions and others, have a large number of articles of utility of various kinds, which they have obtained from Peary, so that they, in regard to arms, tools, etc., are better provided than their countrymen in the southern part of the country.

The Eskimos have always been quick to grasp the objects of my expeditions and in the later ones eager to concentrate all their energy upon

the task of achieving these ends. As they have come into contact with my parties they have adapted themselves easily and readily to the use of various tools. To be able to depend on the natives to do the work of a white man with the tools of a white man means much to an explorer anxious to avoid taking north a party which would be so large as to be unwieldy.

An arctic traveler in winter-time is often obliged to sleep in an Eskimo igloo, an experience which is not soon forgotten. These igloos are made of stones and earth, and are all built on the same general plan, though an Eskimo can easily tell by the workmanship just who made each one.

Some of the igloos are generations old. Usually existing igloos are used, occasionally new ones are built. Sometimes this is done because an Eskimo, usually a good hunter, wishes to get away from his fellows in order not to help support less energetic ones, and so builds his igloo in a previously unoccupied locality; sometimes because an unusual number of families selects the neighborhood of an expedition's headquarters for a winter's residence. When this happens, the work is usually done leisurely in September, while the family is still occupying the summer tent. Then when really cold weather sets in the family moves into the new house and strikes its tent.

A month is ample time to erect a winter home for an Eskimo family. A hole is first dug in the

ground to form the floor of the house. Around this walls of stones, filled in with bits of moss, are built. The roof is composed of long flat stones placed across the top of the walls and covered with earth, the whole structure finally being banked with snow. The roof is of the cantilever style, the stones being weighted and counter-weighted at the outer edges. When finished, the house is ten or twelve feet long, eight or ten feet wide, and usually six feet high. A small window space is inserted in front, and covered with the thin intestinal membrane of the seal. A hole in the floor leading into a tunnel anywhere from ten to twenty-five feet long forms the entrance.

A raised platform at one end of an igloo serves as a bed for the entire family. Sometimes the earth's surface forms the platform, and the floor space in front of it is made by digging out the earth for a depth of a foot and a half. Sometimes long, flat stones, supported by stones, are used; but more often than not one finds a platform of lumber in those built since the advent of lumber in this land. Sledge-loads of grass are brought in and placed on the platform, and with sealskins and the skin of the deer or bear they have a good mattress. For covering, deerskins are used.

A soapstone lamp on a large stone in front of the platform, where it can be tended by the woman at night, burns day and night, warming the igloo so

that little clothing is needed, and also serving as a stove for cooking. For fuel, for light, heat, and cooking, small pieces of blubber are cut, and laid in the shallow lamp close to a long wick of pulverized moss. The burning moss, trying out the oil of the blubber, gives a remarkably hot flame. Formerly they used flint and steel from a vein of pyrite for ignition, and pieces of soapstone, of which there are a few veins in their country, were used for lamps and pots. They now are supplied with matches and lamps and cooking-utensils of metal.

While a night spent in one of these ill-smelling homes with a family of Eskimos is not exactly pleasant, a man engaged in polar work cannot be too particular, and warmth, supper, and sleep even amid such surroundings are welcome to a tired, cold and hungry traveler at the end of a long march.

In the spring these houses become damp and unfit for habitation. The roofs are removed to dry the interior, and the family takes up its residence in a *tupik,* or tent of skin, from June to September. Tents are made of ten or twelve sealskins sewed together. This large piece is stretched on poles, with the hair inside, and is high in front and slopes toward the back, the edges being weighted down with stones. The floor of earth varies according to the size of the

ESKIMO WOMAN, FULL SUMMER COSTUME

ESKIMO MAN, SUMMER COSTUME

family from six to eight feet in width and from eight to ten feet in length.

One of the most valuable things we have learned from the Eskimos is the building of snow houses, a necessity when a party is in the field during the winter months. A snow igloo can be built by four good men in about an hour. First blocks of snow are cut out with strong, stiff saw-knives about a foot and a half long, with saw-teeth on one side and a smooth cutting-edge on the other. The blocks for the bottom layer are sometimes two or three feet long by two feet high,—sometimes smaller,—while those for each succeeding layer are made smaller and less heavy. If the snow is hard, the blocks need to be only six or eight inches thick; but when the snow is soft, they must be thicker in order to hold their shape. Each block is placed on a curve to make an ovoid when all are put together. For a party of three men the interior of an igloo should be about eight by five feet; for five men these measurements should be increased to ten by eight feet to allow for a wider bed platform.

If possible a sloping snow-bank is selected for the site of the house, and when enough snow blocks have been cut out, an Eskimo takes his place here, and as the rest bring up the blocks, setting them on edge end to end in an ovoid about him, he fits and joints them with a snow knife.

The second row is placed on the first with a slight inward slope, each block being held in position by the one on either side. On this another layer of blocks is set; and so on, each slanting inward a little more than the tier below it, until at last there is an opening at the top just large enough to take one block.

The Eskimo in the igloo shapes a block, pushes it through the opening endwise, reaches out, turns it over, and lowers it into its place, afterward chipping it off with his knife until it fits perfectly tight. At one side of the igloo, at the bottom, an aperture, large enough to permit a man to crawl through, is cut. At the farther end of the igloo the slope is leveled off for a bed platform, and a space in front of it is dug out for standing room and cooking-utensils. All the superfluous snow is then thrown out the door, and the cooking-outfit and sleeping-gear are brought inside. When the party turns in for the night, the entrance is closed by a large cake of snow.

It is doubtful if the North Pole would ever have been discovered with our present means and facilities but for the help of the faithful Eskimos, and it is an absolute certainty that it would still be undiscovered but for the Eskimo dog to furnish traction power for our sledges, thus enabling us to carry supplies where nothing else could carry them. All kinds of methods and devices such as balloons, motor-cars, ponies, trained polar bears,

reindeer, etc., have been suggested in connection with the attainment of the pole, but all are unsuitable.

These Whale Sound Eskimos could be of great value in antarctic work, but there are probably not more than four men living who have experience to use them.

The whole animus of the polar regions is against machinery, and those regions are the last places in the world in which to try out or develop an untried device. Even devices which work satisfactorily in temperate regions are more than likely to fall down when called upon to perform under the handicap of polar conditions.

Sooner or later—and usually sooner—any machine will fall down in polar work, and when it does so it is simply a mass of old junk which neither men nor dogs can eat, and which cannot even be burned to cook a pot of tea.

The use of ponies, for which the British have shown a great predilection in antarctic work, is not as efficient or simple as the use of dogs.

Assume that a pony is equivalent in tractive force and weight to a team of ten Eskimo dogs, which is approximately correct. Then as between two expeditions having an equal amount of tractive force and equal weight of motors, one in the form of ponies and the other in the shape of dogs, the former will have ten motors and the other one hundred, and the motors of the former

will each weigh ten times as much as the motors of the latter. Every motor that one expedition loses means a loss of ten per cent of its tractive force, while every motor that the other loses means only one per cent loss.

In crossing thin sea ice the concentrated weight of a pony will cause him to break through with almost certainty of loss, while on the same ice the dispersed weight of ten dogs will enable them to cross in complete safety. On the Antarctic Barrier and the great interior snow-cap, in crossing the snow covering of the deadly masked crevasses, a pony will break through and be lost when a team of ten dogs will cross and never know the crevasse existed.

Dogs require no assistance during the march and no care or shelter at the camps, and when it comes to the matter of food, then everything is in favor of the dogs. With dogs as motors, the food for the men and fuel for the motors are the same —pemmican. With ponies it is a different and a bulkier article. When a pony dies, or is no longer needed as a result of the reduced loads, he can be eaten by the men of the party, but is not available as fuel for the other ponies. When a dog is no longer needed, he can be eaten by the party or used for fuel for the other motors, and in this way not an ounce of material is wasted.

With two kinds of food, pemmican and dog meat, at his command, both equally available for

dog or man, the leader of an expedition, watching his party with the same care that an engineer watches a running motor, can adjust his food-supply to meet varying conditions and without wastage. He can put his party on reduced rations and keep up the number of his dogs to increase the speed and take all work except that of walking from his men, or he can feed the dogs to each other, and so conserve the amount of pemmican available for the men alone in the latter part of the journey. In this way every ounce of food in the party, whether in tins or "on the hoof," is utilized, and can be used at the time and in the way that will be most effective. I could dilate at very considerable length on details of this method, but it seems as if its simplicity, efficiency, and flexibility must be self-evident to every reader. A leader who has once tried this method will never handicap himself with any other. With apologies for my assurance in the matter, I may say it is absolutely the *only* method.

The whole difference between Amundsen's dash to the South Pole—a picnic as he characterized it, and actually that relatively as antarctic trips go—and Scott's heroic struggle and tragic finish may be expressed in four letters, *dogs*.

This is said not in a spirit of criticism, but of sorrowful fact. Amundsen and his men, when they made camp at the end of each march, were tired in every bone, as is every member of every

serious polar sledge-party; for handling a sledge is like handling a breaking-up plow in new land. But the dogs had done the major part of the work, and the men still had a reserve of physical and nerve force left. When Scott's ponies failed him, he and his men dragged their hearts out pulling the sledges, and when they made camp at the end of a march they were all in. When finally, within eleven miles of their depot of supplies, the blizzard caught them at the physical dead center, there was not an ounce of reserve force left in the entire party to permit reaching the depot. And so they died. Ah, the pity of it!

When dogs as tractive force are compared with men, then the results are startling, as the following instances will show.

The winter quarters of the *Alert* of the British Arctic Expedition of 1875–76, and of the *Roosevelt* in the two expeditions of 1905–06 and 1908–09 were essentially the same, Cape Sheridan on the north shore of Grant Land. Northwest along the coast were Capes Joseph Henry, Hecla, and Columbia. The British parties, using man power for dragging sledges, were five and more days going to Cape Henry in various trips. My parties, using dogs, went regularly to Cape Hecla beyond Cape Henry in two marches, and returned in one.

Aldrich, in one of the principal spring sledge-journeys of the expedition, was twenty-seven days to Cape Columbia. My parties, with loaded

sledges, made it regularly in four marches, returning in two. Bartlett, on one occasion in the autumn work, came back the entire distance in one march. My North Pole party, after reaching land and resting and feeding men and dogs for two days at Cape Columbia, made the journey to Sheridan in two marches.

Even when compared with the journey of Lockwood and Brainerd from Conger to Lockwood Island, using southern Greenland dogs and driver, the journey of MacMillan and Borup along the same coast from Cape Sheridan to Cape Morris Jesup is instructive. Lockwood and Brainerd were twenty-five marches from Conger to Lockwood Island and sixteen marches on the return.

MacMillan and Borup went from Cape Sheridan (nearly the same distance as Conger) to Cape Jesup forty miles beyond Lockwood Island, in much less time and on the return covered the distance in eight marches averaging thirty-four miles per march.

In 1911 I was in London with Scott for two weeks before his expedition started for the South Pole, was on his ship, the *Terra Nova,* the day she steamed out of the London docks, and I talked dogs and dogs with him, but without results. Possibly it was too late for him to make any change. I have repeatedly talked dogs to Shackleton, and before his last expedition urged upon him the desirability of dogs, dogs, and yet more dogs.

I was met by the statement that dogs could not be driven in the driving snow that sweeps along the surface of the antarctic ice-cap. But for my experience in my earlier expeditions across the Greenland ice-cap, where identical conditions are encountered, I might have accepted this. In my Greenland work members of my parties drove their dogs day after day in a low, blinding drift of snow sweeping along the surface of the ice-cap with the steadiness of a stream of water.

I was interested very recently to hear Shackleton in San Francisco, in the first public lecture given after his return from his last antarctic expedition, express unreservedly his conversion to a belief in dogs.

As a matter of fact, the Eskimo dog is absolutely the only motor for polar work, and will remain so until superseded by the aëroplane.

These sturdy, magnificent dogs can do a greater amount of work on less food than any other animal. They eat meat and meat only, and for water they eat snow. Even a month-old puppy is hardy enough to stand the coldest weather, and it is not necessary to house them at any season of the year. In appearance as well as in usefulness they are remarkable creatures. The males weigh on an average from eighty to one hundred pounds, the females of course being rather smaller. These dogs, said by some scientists to be descendants of the arctic wolf, are of one breed only, but are

ESKIMO KING DOG

found in a variety of markings and colors, gray, black, yellow, brown, and mottled. The pure blooded type dogs are marked like the arctic white wolf. In my opinion there is no handsomer dog to be found than one of these Eskimo dogs, with its pointed muzzle, sharp-pointed ears, and wide-set eyes, shaggy coat, and bushy tail, and as a rule they are obedient and affectionate as any dog.

In purchasing dogs at Cape York I have always secured enough to allow for the loss of sixty per cent. of them by accident or sickness. It is impossible to count on the length of an Eskimo dog's life. They will go through the severest hardships, work hard on almost nothing to eat, and stand exposure to the worst storms, and then with plenty to eat, nothing to do, will suddenly die or be taken with *piblokto,* a malady which has threatened at times to completely cripple my expeditions and to wipe out one of the most valuable resources of the Eskimos, and for which there is no known remedy. A victim of this dread disorder refuses all nourishment and howls and snaps, biting any other dog it comes in contact with, and often dies of convulsions the same day it is attacked.

CHAPTER VIII

UTILIZING THE RESOURCES OF THE COUNTRY

ONE of the basic principles of all my polar expeditions has been to depend upon the country itself for the fresh-meat supply. To this fact is due the entire absence of scurvy on all my voyages. Contrary to a general idea, the polar regions of northern Greenland, Ellesmere Land, and Grant Land have for the experienced hunter a considerable and most attractive fauna, and while there are certain parts where it is virtually impossible to find even so much as a stray polar hare, there are other regions where a very fair amount of meat can be obtained in a comparatively short time by those knowing how, and acquainted with polar topography and the habits of polar animals.

The polar bill of fare includes fish, flesh, and fowl in considerable variety. The walrus and seal of the Eskimo are, of course, known to every child. Both furnish a strong and healthy diet, but few white men become really fond of it. There are, however, other animals in the region which furnish delicacies that would grace the table of the finest hotel in any great city, as the musk-ox, rein-

deer, and polar hare. Polar bear, if young, makes a very acceptable steak. At any age the meat is not at all disagreeable when frozen and eaten raw.

Of the sea animals, in addition to the walrus and the ringed or floe-seal, there are the harp- and the square-flipper-seal, the flesh of both of which possesses a much less pronounced bouquet than the walrus and the floe-seal.

Of birds there are various kinds; the most abundant are the little auks, and next the Brunnich's guillemot. Then there are the eider-duck, the long-tailed duck, the brant, and the king-eider. It is possible also in some localities to get an occasional mess of ptarmigan, the arctic white grouse. The various species of gulls are considered fine eating by the Eskimos, but they are a bit rank to the white man.

Of fish there are two kinds, the grayling and a species of char that we called rather affectionately salmon-trout. In September, 1900, this latter fish kept alive for about ten days my party of six men and twenty-three dogs. It is undoubtedly the finest fish food to be found anywhere, in color a pale pink, like salmon or unripe watermelon. Living in water never warmer than forty degrees, perhaps never above thirty-five degrees, it is the sweetest, firmest fish fiber in the world.

It is no small task to secure a supply of meat sufficient to keep hundreds of dogs alive and in good condition all winter, and to provide fresh

meat for a crew of over twenty and some fifty Eskimos. Hunting parties must be kept constantly in the field during the autumn months to meet the demand.

The mainstay in the way of food for the dogs is walrus, and weighing anywhere from 1000 to 3000 pounds, they provide the maximum of meat at a minimum of time and energy. During the months of July, August, and September these animals are to be found in large herds in Wolstenholme and Whale Sounds, where they assemble to feed on the shell-fish abounding in those shallow waters. Here they may be seen basking in the sun on the ice-floes and cakes of ice, singly, or in groups ranging from two or three up into the hundreds. I have seen anywhere from one hundred to one hundred and fifty walrus on one large ice-pan, with an equally large number in the surrounding water; but only on Littleton Island, in Smith Sound, and along the shore of the mainland opposite have I ever seen them on the rocks. It is worthy of note that during the summer months males only, and chiefly the old ones, are to be found in Wolstenholme Sound, the females, calves, and young males haunting the waters about Littleton Island and Oomenak Sound.

A few walrus are secured by the Eskimos in these waters during the summer, but the bulk of the annual catch, at least two-thirds and possibly three-quarters, is made at Cape Chalon in the

GIANT POLAR BEAR KILLED IN BUCHANAN BAY, JULY 4

Note the size of the paws and forearm. A single blow from such a paw sometimes dis- [illegible] Eskimo, smashes all his ribs, or crushes his head like an eggshell

spring. Virtually all the walrus of this region winter in the open north water off Cape Chalon, sometimes separated from the cape by ten miles of ice, sometimes by twenty-five. Strong winds break up the ice along the edge of the north water early in February, making the distance for an Eskimo to drag his sledge from Cape Chalon just so much less. This breaking up of the border ice is usually followed by low temperatures, which in a few hours make the new ice strong enough to support a sledge and dogs. The hunters leave the cape early in the morning and, driving out to the edge of the old ice, tie their dogs, and with a lance, harpoon, and line begin a search out on the new ice for the walrus. On sighting an animal, a hunter harpoons it, takes a turn of the line round the harpoon-shaft, sticks the harpoon into the ice, and braces it with his foot, while a companion lances the lungs or heart of the huge creature. As soon as the walrus is dead it is pulled out upon the ice, cut up, and placed on the sledges, which have meanwhile been brought out, and is ready to be carried back to the settlement. These hunts are continued until late in the spring, and large quantities of meat are secured.

Hunting walrus in a small whale-boat, however, furnishes the most exciting and dangerous sport north of the arctic circle. With an Eskimo crew at the oars; a sailor at the steering-oar; two other Eskimos, experts with the harpoon, in the bow;

an experienced man in the bow with a rifle; and Bartlett or me in the stern, just in front of the man at the steering-oar, we considered a boat well manned. In the way of equipment there should be at least three repeating-rifles, with abundance of ammunition; six or eight harpoons, with lines and floats, spare boat-hooks, and a heavy, short-handled ax for each man, for smashing the walrus in the face when they try to come aboard. A good supply of old coats or blankets should be taken along for plugging up holes punched in the boat by the tusks of the walrus.

At the faintest suggestion of smoke walrus will quickly disappear in the water, and a party nearing a herd of these huge creatures by steamer should keep to leeward of them if possible, and take to the small boats when still far enough away to prevent its presence being detected by the animals. The whale-boats should always be white, to give an appearance of cakes of ice, and the oar-locks carefully muffled to reduce the noise of approach to a minimum. It is a comparatively easy thing to harpoon a walrus asleep on an ice-pan, and sometimes by using small bergs as a screen to hide behind, a party can approach to within a few yards of a herd and harpoon several before they are fully awake. In most cases, however, twenty yards is the nearest a boat can get before the walrus are aroused, and begin to slip into the water. A few shots quickly decide

whether they are going to fight or beat a retreat, necessitating a long chase possibly, and adding to the difficulty of harpooning them.

The harpoon equipment of the Eskimo is made up of a tough line of the hide of the square-flipper-seal, one hundred feet long, attached to an iron-edged ivory head fitting on the end of a heavy harpoon-shaft of wood. The other end of the line is attached to an entire sealskin inflated, and some distance from the end is fastened a rectangular drag, attached, like a kite, by a bridle-line. The float, remaining on the surface, marks the position of the animal and prevents its going deeper than the length of the line. Only the largest and most powerful bull walrus can drag it under, and that only for a few minutes. The float also keeps the animal from going to the bottom and being lost after being killed. The drag retards the movements of the animal and tires him out.

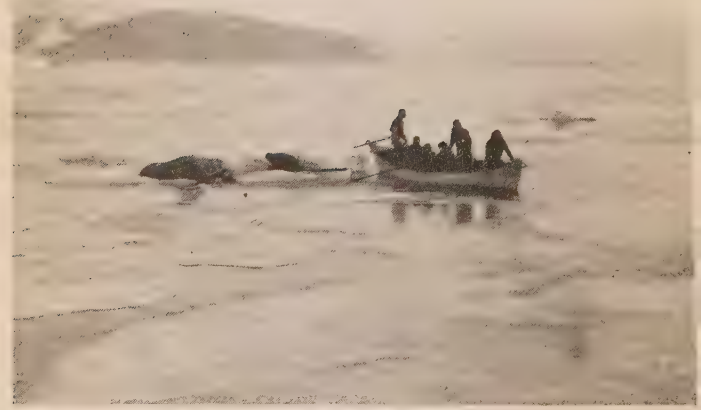
The Eskimo in charge of the harpoon has his line coiled beside him in the bow, with the harpoon-shaft laid across the gunwales. A few coils of the line are separated from the rest and placed a little to one side, where they can be easily and quickly grasped and held in his left hand as the harpoon is launched, thus allowing the line to play out easily. As soon as a walrus is harpooned, line, float, and drag are thrown overboard. Care should be taken to give the flying line a clear berth, for to be caught by a turn of it would mean

at least a wetting and possibly more serious results.

In an attack by fifty or more of these infuriated beasts a small whale-boat is no place for a nervous person, and I have known Eskimos, accustomed for years to such encounters, when surrounded by these huge, ivory-tusked creatures, with angry, bloodshot eyes, emitting vicious roars through thick, stiff-bearded lips, and making savage attempts to get at the occupants of the boat, to lose their heads so completely as to drop their harpoons, begin to yell, and even to spit at their formidable foes. At such a time every one seizes an oar, boat-hook, or anything solid, and, as the brutes attack, hits them over the head to keep them at a respectable distance from the boat while the men at the rifles do their work. In several encounters I have had a harpooned walrus draw the line taut and, before he could be finished with a bullet, race off, with us in tow, crashing into any ice which might be in our course, knocking the startled Eskimos from the thwarts, with the rest of the herd following, snorting and charging on all sides. A walrus can with the utmost ease plunge his tusks through several inches of new ice, and it is no uncommon occurrence for one to dive and come up under the boat, ripping a hole in it, and necessitating a hasty retreat to firm ice.

The modus operandi of my big, systematic wal-

BRINGING NARWHAL ASHORE



WALRUS HUNTERS AND THEIR KILL

rus hunts to secure the maximum amount of meat in the least time was as follows:

As many harpoon outfits as possible, fifty sometimes, complete with floats and drags, were assembled on my ship, with the best harpooners of the tribe. Then two, three, or four of my whaleboats were kept at work, each supplied with six or eight outfits. The galley was kept in commission continuously supplying hot coffee, baked beans, and pilot-bread, and one of the officers remained in the crow's-nest (a barrel at the mast-head) with a telescope, locating the cakes of ice that had walrus on them. Sometimes when the walrus were numerous all the boats would get away at the same time in different directions. Sometimes one would start out, and then the ship would steam on and drop another and then another. Each boat kept at the walrus until it had all its harpoons and lines fast to the animals, and perhaps two or three dead with rifle-bullets on the ice. When all the lines and floats were out, the boat would pull round to each float where an animal was still alive, despatch it with a rifle, then, if the ship was near, go aboard for lunch, or, if far off, stand an oar on end whaler-fashion and wait its arrival. The ship, with the gangways in the bulwarks amidships taken out and a narrow staging rigged down the side about a foot above the water, would then steam alongside each float in turn, a man on the

stage would pass the float up to the deck, and the walrus hanging dead in the water down the length of the line, would be pulled to the surface, the man on the stage with a sharp, strong knife would cut a slit in the tough hide, insert the hook of a heavy tackle and fall, the man at the steam-winch would turn on steam, and in a minute or two the huge brute would be dropped in a brown mass on deck. A young Eskimo would jump forward, cut out the harpoon, and take line, float, and drag aft, coil them carefully for use again, and the old men and women would quickly skin and cut up the animal. By the time all of one boat's kill had been brought aboard her crew had had their lunch, and, if other walrus were in sight, went away again after them, or, if none was in sight, waited till the masthead man sighted more.

In this way forty walrus have been obtained in a night or a day's hunt, and two hundred and fifty in two weeks' work. On one or two memorable hunts they came in so fast that it was impossible to skin and cut them up till the hunt was over and every one had had a good sleep. At these times the deck was hidden under the huge, brown, shapeless forms, and the ship listed heavily to one side with the top-heavy load.

In hunting walrus only powerful rifles should be used, and even with them knowledge of how and where to shoot will save an enormous expenditure of powder and lead. It is utterly use-

less to shoot walrus in the body. For a side shot, a spot on the head as far back of the eye as the eye is back of the nose should be hit. Here the small brain has less protecting skull about it. The back of the head is also vulnerable. A frontal shot is almost an impossibility. The only chance is, when the walrus opens its mouth, to put a bullet between the tusks down the throat and smash the vertebræ at the base of the skull. This shot is most likely to occur with a number of bull walrus in the water close about the boat. On several occasions a bull walrus, rising with a rush close to the boat and opening his mouth to bellow, has been surprised by a shot of this character, and gone like a rock to the bottom. On one occasion a harpooned animal, while fast to a line and float, invariably rose to the surface facing the boat, and had the entire front of its head back to the eyes literally smashed off, tusks and all, by eight or ten shots before he was killed. It is an utter waste of powder and walrus meat to shoot these animals in the water unless they have been harpooned and are fast to a line and float. If instantly killed, they go to the bottom like rocks. If mortally wounded, they struggle to the same place. On a few occasions, in shooting a walrus in the back of the head, the blow of the bullet that killed it instantly forced its head under water, giving the air in the lungs no chance to escape, and the animal floated with

a bit of the back exposed till a float could be fastened to it. But these cases are rare, and in my later expeditions my invariable orders were never to shoot a walrus in the water unless it already had a line fast to it. Even when shot on the ice, unless it is a large floe, one is never sure of an animal until it is aboard or has a float fast to it.

The inert collapse of half a ton or more of flesh and bone under the impact of a bullet in the brain is sufficient to tilt a small ice-pan and slide the dead walrus into the water. The slightest touch of the ship as she forges alongside the cake to hoist the animal on board will have the same result, and on two or three occasions when I have lowered a boat to put a man on the ice and make a line fast to the animal, the man's weight has been enough to disturb the balance and throw the precious meat into the water.

Now that the United States has given up all her rights in Greenland to Denmark, it is quite likely that an embargo on walrus hunting in the Whale Sound region will be attempted as has been the case for years in southern Greenland.

In such event polar expeditions by the Smith Sound route may find it desirable to obtain dog food in bulk for winter use at headquarters from the whale factories of the Labrador coast. It will not be as satisfactory as the walrus meat, but it may serve the purpose.

Seen a few feet under one's boat in the pale-green, icy water of Whale Sound, a herd of rushing walrus, as swift and sinuous as seals, the great uncouth, gray shapes rolling from side to side to leer upward with little, bloodshot eyes and show a flash of white tusks, is like a nightmare dream of the inferno.

Stuffed and baked, the heart of the walrus is as great a delicacy as a beef heart. Dr. Senn, a Chicago traveler and writer, a summer visitor on one of my auxiliary ships, was greatly captivated by it, and Percy, my Newfoundland steward of numerous expeditions, incited by the praise of his discovery, became a blue-ribbon chef in cooking it. Some explorers have highly praised the walrus liver and urged its value as a preventive and cure for scurvy. Never having been obliged to use it for that purpose, and spoiled perhaps by the more delicate seal, reindeer, musk-ox, and hare livers, the members of my expeditions never seemed to care for it.

The thick, tough hide of the walrus furnishes a dog food of wonderful staying qualities. A small piece of it when frozen will keep the strongest-jawed Eskimo dog occupied and interested for hours in his efforts to soften it to the point where he can swallow it whole.

I have always taken on just as much walrus meat and blubber as the ship, already filled almost to her capacity with coal, etc., would allow—some

fifty walrus, perhaps. This, together with seventy or more tons of whale meat bought at Labrador, has carried the dogs through the winter, and has also helped feed the Eskimos, who virtually live on narwhal, seal, and walrus. The narwhal and seal also make valuable dog food, the former being found in the Whale Sound region; but on my last expedition north there was virtually no narwhal hunting.

Seals are obtained in abundance at Cape Chalon, the spring hunting-ground of the Eskimos, and at the end of some seasons large piles of this meat are stacked along the ice-foot at the village. Equipped with a seal spear, and dressed in the warmest of furs, with feet padded with bearskin to muffle their tread, and with small three-legged stools, men, boys, and even women may be seen sitting for hours beside a hole in the ice waiting for a seal to appear for a breath of air. Occasional seals were always captured on our way to and from winter quarters, and they frequently appeared near the ship during the winter.

For the fresh-meat supply of my men I have always depended on the musk-ox, and on all my expeditions have been able to find numbers of these animals within a radius of a hundred miles of the ship or other winter quarters. They can be found at any time of the year, even during the long polar night, by those who know how. The grass and creeping-willows furnish subsistence

for them the year round, the strong winds peculiar to those regions sweeping large tracts of land bare of snow in winter, thus enabling them to eke out an existence.

I killed my first musk-ox in 1892 on the northeast coast of Greenland near Independence Bay, and three years later discovered tracks of fifteen or twenty in the same region, and secured six of them. During my expedition of 1898–1902 numerous musk-oxen were killed about Fort Conger, seventy-odd in its immediate neighborhood; forty in the region from Discovery Harbor westward by way of Black Rock Vale, and the southern side of Lake Hazen, seventeen about St. Patrick's Bay, three beyond Black Cape, near the winter quarters of the *Alert;* sixteen in Musk Ox Valley; twelve at the Bellows and Black Rock Vale; seventeen on Bache Peninsula; twenty at the northern arm of Buchanan Bay, and one at its southern arm; seven on the ice-cap of Ellesmere Land; and in the autumn of 1900 one hundred and one were killed in various localities from Discovery Harbor to Very River, ninety-two of them being secured in less than three weeks. In the region about Cape Morris K. Jesup two herds numbering fifteen and eighteen animals were discovered, and two or three stray ones, but only four of these were needed for my party.

My 1905–06 expedition secured its supply of musk-ox meat chiefly from the drainage basin of

Lake Hazen. The northern side of the lake had not been drawn upon for years, and hunting parties in this region, covering the southern slopes of the United States Range, met with great success. Eskimo hunting parties also covered the country from Lake Hazen and Wrangel Bay northward to Clements Markham Inlet with almost as satisfactory results. A few animals were killed on the way north on Bache Peninsula, and if it had not been for the discovery of a few of these animals on my return from 87° 6′ my party would never have reached the ship. Luckily seven musk-oxen were found in Nares Land, and later on my western trip we secured seven more near Cape Columbia.

The presence of musk-oxen can be detected very quickly by the patches of luxuriant grass which mark all their rendezvous, although along the inhabited parts of the Greenland coast an unusual growth of grass may be a sign of a former igloo. A careful examination of these places will soon show whether musk-oxen have been about, bits of wool and hair shed from their shaggy coats being scattered here and there on the ground, while their tracks show how recent has been their visit. Fresh tracks of musk-oxen being discovered, it does not often mean a great distance to travel before the animals themselves are sighted; and musk-oxen once seen may be considered dead musk-oxen by an experienced hunter with a good

A MAGNIFICENT BULL MUSK-OX

REINDEER OF 83° N. LAT.

Buck, doe, and young of new species of white reindeer named by Dr. J. A. Allen "Rangifer Pearyii"

dog or two. On approaching to within a mile or so of them, the dogs are let loose, and the hunter can follow at a comfortable pace, knowing that on his arrival the herd will be rounded up. A musk-ox, if alone, will retreat to the nearest cliff and back up against it at the appearance of dogs. A herd, however, will round up anywhere, with their tails together, facing the intruders, while their leader takes his stand on the outskirts of the group and charges the dogs as they come up. As soon as the leader is shot, another steps out from the herd to take his place, and so on. When things begin to look too bad for them, they will sometimes make a wild break to escape, or the whole herd may charge the enemy.

With the musk-ox, as with the walrus, knowing how makes all the difference in the world in the amount of ammunition expended and the amount of meat secured. With the exception of a few months in summer a strong rifle is required, as the pelt of the musk-ox is very thick and heavy. With a suitable rifle and some experience one shot to an animal should be sufficient.

In my 1900 sledge trip round the northern terminus of Greenland I obtained ten musk-oxen and a polar bear with twelve cartridges. Two of these were expended on the bear. In a very successful late September afternoon hunt on the north side of Lake Hazen I secured twenty-five musk-oxen with twenty-six cartridges, two being

expended on the bull leader, which my first hurried shot had stopped, but not killed, in a charge on my dogs. At another time, the others of my party being away, I took a solitary scout from camp with only an army Colt 45. With the six shots in this I got five bull musk-oxen.

On the other hand, in the narrative of the *Polaris* expedition, it is stated that some of the crew expended three hundred shots on one animal, and then, while they went after more ammunition, it left.

With the musk-ox, as with the walrus, in my later expeditions I hunted them on a large scale and in a systematic way, with careful attention to details to secure the largest amount of meat and not waste an ounce. All hunting parties had detailed orders.

Musk-oxen were to be shot back of the fore shoulder or in the neck, at the base of the skull. These are the instantly fatal spots. Frontal or head shots are a waste of ammunition. Skins were removed with feet and legs attached, rolled up in bundles to fit the sledges, and taken back to the ship to be thawed out and carefully prepared by the Eskimo women at their leisure during the winter. Hearts, livers, and kidneys were removed, laid out to freeze solid, then stored under rocks away from dogs, wolves, and foxes until sledged back to the ship. The remainder of the viscera was fed to the dogs on the spot. The

heavy backbone, pelvis, and leg bones were cut out, the marrow bones cracked, and their contents eaten at the hunting-camp. The others were thrown to the dogs to gnaw clean. The great brick-red hams, fore shoulders, and balls of meat from the neck and ribs, all frozen like granite, were then piled in a big stack, to be sledged to the ship from time to time during the winter. In this way nothing was wasted; the bones and viscera were utilized on the spot, and only the clear solid meat had to be hauled over the arduous trails.

There is constant excitement in traversing musk-ox country. One can never tell when the opening up of a valley or a turn around a cliff may bring one or a herd of the shaggy animals into view.

On two occasions the discovery of musk-oxen saved my sledge-party from starvation, and the discovery was not due to happy chance or accident, but was the result of careful, intelligent search in suitable localities, examining every slope and valley and rock within range of field-glasses, carried for that special purpose, and as much a part of the hunting equipment as the rifle.

When I stretch myself or drop my hand on the thick, black felt of the musk-ox robes in my study, the touch of them conjures up many a vivid picture, and I have a more than friendly feeling for those strange, black denizens of the highest North.

The favorite haunts of the reindeer are the rolling, grassy slopes about the landlocked lakes of the North, where the pasturage is abundant, and they are sheltered from the cold sea-fogs and the sharp winds from the ice-cap. These animals, or traces of them, have been found by various explorers in Rawlings Bay, the region about Fort Conger in Grinnell Land, and at Alexandra Haven in Ellesmere Land, and they have been reported in considerable numbers on the western side of this land. In 1901 one of my men found an antler as far south as Erik Harbor.

In the region about our winter quarters in McCormick and Bowdoin Bays in 1891–93 and 1893–95 deer were most plentiful. During the autumn of 1891 one was killed on the plateau just back of Red Cliff House; two boat-trips to the head of McCormick Bay resulted in fourteen being obtained, and soon after ten were found on the northeast side of the bay in Five Glacier Valley. The following spring eleven were added to our larder, two from Five Glacier Valley, one from Cape Cleveland, the rest from Bowdoin Bay. In 1893 I visited the southern slopes of the northern side of Olriks Bay, a favorite resort of the deer. Five hours' work added seventeen deer to our meat supply, and thirty-three were killed later in the same place; seven were seen in the neighborhood of Cape Athol, but only one was bagged. In January, 1894, hunting parties sent out to the

deer pastures of Kangerdlooksoah were very successful, bringing back fifty-four animals.

In 1905–06 we got eleven deer on the northern coast of Grant Land; a party sent out to Porter Bay returned with the meat and skins of seven; and seven more were obtained from a herd of eleven discovered on Fielden Peninsula. These reindeer were the first of their kind ever found, magnificent animals, almost pure white in color, designated by naturalists as a new species. Later these were found to be numerous in the region between Lake Hazen and Cape Hecla and along the coast of northern Grant Land to the westward, fifty-odd being killed.

On my last expedition a Porter Bay party brought in fourteen of the animals; three were picked up not far from the ship, and a stray one in James Ross Bay.

A deer means a week's rations added to the meat supply of the party, and the realization of this when bringing one down is far from being an unpleasant sensation.

Of course deer hunting is much the same the world over, but the Eskimos have a magic call to these animals which has been taught to the young hunters of every rising generation. It is similar to the hissing of a cat, only more prolonged, and will cause a fleeing buck reindeer to stop instantly in his tracks, giving the desired shot.

To most polar travelers and explorers, and to

all readers, the polar bear, sometimes called the "Tiger of the North," has loomed largest as the "big game" par excellence of the North. I know of nothing that will excite an Eskimo so much as the sight of one of these huge creatures in the distance; but a contest with even three or four bears and a man armed with a Winchester is always one-sided and tame sport in comparison with a lively walrus hunt.

None of my expeditions has had the exciting bear adventures of others. Bears never have attacked us, or come poking into our tents while we were asleep. No member of my party ever had a hair-breadth encounter with one. We hunted them assiduously, partly for the meat, but more for skins to supply us with trousers for the long sledge journeys, and we were able to secure only enough for this purpose.

My visualization of a bear hunt is the constant watching of the ice-floes about the sledge with eyes and field-glasses, the glimpsing of a cream-colored spot slipping behind an ice pinnacle, or of great tracks in the snow. If the bear has heard the dogs, the tracks are a series of huge leaps headed directly away from us; the loosening of two or three of the trained dogs, the rapid overhauling of the bear, a single shot, or at the most two, and then strenuous efforts to keep the crazy dogs away from the carcass while it is skinned, cut up, and loaded on the sledge.

Though classed among the pure carnivora, the Eskimos say that the polar bear of that region when unable to secure seals will take a "hike" across country, and fill up on grass like a reindeer.

I believe this to be true. An enormous male bear which I killed on the Fourth of July in Flagler Bay was big bellied as a cow, and the stomach was distended with grass.

In 1886, at Ravenscraig Harbor, on the south side of Eglinton Fiord, a fleet of four whalers and the *Eagle* obtained ten bears, two of these being harpooned in the water by the crew of the *Eagle.* So enraged was one of the animals that the crews of three boats were required to keep the bear from climbing into the *Eagle's* boat to wreak vengeance on the occupants. Just north of Cape Hooper we got three more bears in the ice-pack. It is not always possible to bring a bear down with the first shot when he is traveling over rough ice, but there need be no doubt as to whether a shot has reached its mark or not, for a wounded bear will always make savage snaps at the spot stung by a bullet.

In July, 1891, we obtained one bear in the Melville Bay ice-pack, and pursued an old bear with her two cubs for some distance, but they made good their escape. The next spring one of my Eskimo hunters came upon a young bear near Cape Parry, and in the spring of 1894 five were brought in from Kane Basin.

During my 1905–06 expedition one bear was killed near Cape Sabine, another in crossing Kane Basin, and two on the northern shore of Bache Peninsula. Only one was obtained during my last trip, and that in James Ross Bay; but on our way from Cape Columbia to the pole we discovered fresh polar bear tracks over two hundred miles from land, and on our return came across tracks of what we believed to be the same bear.

Actual measurements of the broad plantigrade footprints of a bear on one of my earlier expeditions gave a width of eleven inches, with a length of twenty-two inches; but the dragging toes and hair of the animal's heels in the soft snow made a much larger trail, closely resembling that of a man on snow-shoes.

Chief among the smaller animals of the North are the polar hares, which are found occasionally on southern slopes, even as far north as the northern shores of Grant Land. Like the penguins of the antarctic regions, they have not yet learned to fear man, and it is possible to get almost close enough to pick them up. On my last expedition members of the party discovered hundreds of these little animals around Lake Hazen, and succeeded in getting near enough to hit them over the head with their rifles instead of shooting. A stray hare or two picked up on sledge-trips make a very acceptable change in the monotonous diet of pemmican.

SECURING BIRDS AT THE BIRD CLIFFS

HARE HUNTING AT 83° N. LAT.

While it can scarcely be said that the sea-birds of the North are hunted, still thousands upon thousands of little auks and guillemots are caught every year by the Eskimos with their nets, and laid by for the long winter. At Red Cliff House, in 1891–93, millions of these birds were to be seen in the summer months, and boat-trips were made to the loomeries of Hakluyt, Northumberland, and Herbert Islands for a supply of them. In the clefts of the perpendicular cliffs of these islands the Brunnich's guillemots breed by the thousands. Our method of capturing them was to run the boat up to the cliffs after as many as could be kept track of had been shot, and while one man collected the dead birds, another kept the boat off the rocks with his boat-hook. Not over thirty per cent. of the birds killed would fall into the water, the majority of them catching on the cliffs, where it was impossible to get at them. Millions of guillemots, kittiwakes, and little auks, as well as numerous looms, burgomasters, and falcons, are to be found along the cliffs between Cape York and Conical Rock. With vast throngs of these birds perched on every projecting rock or ledge, these cliffs appear to be fairly alive. Eider-ducks are on Duck Islands of Melville Bay and McGary Island in considerable quantities. Two stray ones were killed near Cape Belknap in 1907.

Brant also are found on the northern coast of Grant Land; after my return from "farthest

north'' in 1906 we came across groups of ten or eleven, and near Cape Thomas Hubbard I discovered a flock of as many as one hundred of these birds.

The only available fish in the north are found in the landlocked lakes of that region. They will not touch bait, and the Eskimo method of catching them with a spear had to be adopted by us. The native spears are made by setting a nail or any sharp bit of steel in the end of a shaft. Two pieces of deer antler are bound with fine cord to each side of the shaft so that they point downward, and sharp nails are then set in these, pointing inward. A hole is cut in the ice, and a small fish carved from ivory, in which art the Eskimos are surprisingly expert, is dropped into the water. A fish, rising to examine the decoy, is immediately thrust with the spear, which, pressing down on its back, causes the portions of antler to spread, and the nails to sink into its flesh and makes escape almost impossible.

My confidence in the ability of the country to furnish the fresh-meat supply of my expeditions has always been justified by results. Even in 1905–06, when, with the long polar night upon us, I had to face the serious proposition of feeding my dogs and most of my Eskimos entirely upon the country because the whale meat purchased in Labrador proved to be bad and had to be thrown away, I found it possible to subsist them upon the

country's resources. It is quite true, though, that such a thing would have been absolutely impossible had it not been for my thorough knowledge of this region. Nor should I have found an abundance of game along the most northerly lands,—the northern coasts of Greenland and Grant Land,—where Nares and Greely's parties found practically none, and were reduced to most serious straits, had it not been for my previous years of training and experience in how and where to look for polar game.

CHAPTER IX

SLEDGE EQUIPMENT

THOROUGH preparedness for a polar sledge journey is of vital importance, and no time devoted to the study and perfection of the equipment for a long journey can be considered wasted. Upon the perfection of this equipment depends the success of the expedition. It must be devised to meet every condition and every extreme, and my sledge-journeys have always been preceded by days and weeks, even months, of careful attention to the slightest details. To the inexperienced the amount of work this involves even for a small party would be surprising.

The major items of my sledging-equipment, as used in the north pole trip, are as follows:

Eskimos for majority of party.
Eskimo dogs for traction.
Special sledges.
Fur clothing exclusively.
Pemmican for mainstay of rations.
Special device for making tea.
Snow houses for shelter.

The more nearly perfect and simple the outfit and its adaptability to the various conditions to be

encountered in overland or polar-sea sledging, the more the work which can be accomplished, and the greater the comfort and safety of the party.

Every reduction that can be made in the number of articles of food or equipment necessary, and in the number of routine operations or motions that have to be gone through with daily, as making and breaking camp, preparing meals, etc., conserves time, temper, and mental as well as physical energy, leaving more minutes for sleep and more vim for traveling.

Every precaution should be taken to render every article of equipment as impervious to the dangers of injury or breakage as possible. This not only saves the extra burden of a repair outfit, but valuable time in the field. Provisions must be rendered immune from loss or injury by wetting.

Next in importance comes weight. Everything should be just as light as it can possibly be made, for the number of miles a party can travel depends on the amount of food it can carry, and every pound deducted from the weight of equipment means an extra pound added to the food-supply.

The fundamental conditions of the supreme polar sledge-journeys should be fully comprehended. On leaving land to force a way across the surface of the north polar ocean, or leaving headquarters to drive to the center of the antarc-

tic continent, not an ounce of food or supplies or equipment can be obtained on the way. Everything to use or eat on the journey must be carried on the sledges. The load that can be carried upon the sledges is a certain fixed amount, depending upon the character and amount of the tractive power. In my work it was fixed at five hundred pounds for a team of eight dogs.

That load is made up of two parts, the "constant" weights of cooking-outfit, rifle, instruments, etc., and the "variables" comprising supplies which are constantly decreasing as consumed by men and dogs. For every pound of "constant" weight that can be saved by elimination or refinement a pound of pemmican can be substituted, and this is a day's, or, in an emergency, two days', ration for a man or a dog. A saving of nine pounds in the "constants" represents a full day's rations for a driver and his eight dogs, and this transformed into distance may mean anywhere from ten to forty miles.

For tractive power I have always used the Eskimo dogs, and believe they are the *only* thing for such work. Eight dogs are required to haul the standard load, but, with an extra load or for fast traveling, I have sometimes used ten or twelve good dogs.

A good team of eight dogs should always have one or two bitches in it. This makes a livelier and better-working team, and the bitches of the Whale

Sound dogs almost without exception pull harder per pound of their weight than the dogs. If, when bitches go in heat, they are put in the leading team, there is no occasion to use the whip with the other teams.

From every point of view and under every consideration the Eskimo dog is at the present time the only motor for polar work. He is capable of wider adjustment to varying and always adverse conditions than any other; he can go where no other can; he can stand more cold and hardship than others; he uses the same fuel (pemmican) as the men; he requires no water, no special care or attention or shelter; and when he is no longer of use as a motor, he can be utilized as fuel for the other motors or the men of the party.

The first item of equipment to be considered is the sledge. Upon it all depends, and no detail of its construction is too small to be of the utmost importance. It must drag easily and be as light in weight as it can be without the sacrifice of strength for lightness.

Twenty-three years of experience in polar sledge-traveling and acquaintance with all types of sledges have given me clear and definite ideas as to essentials and non-essentials in the construction of sledges.

Those built for my first expedition were modeled on the same general principles as the McClintock sledge, but weighing about one-third as

much. Each succèeding expedition has seen some improvement in our sledge designing and building, and the Peary sledge, used for the first time on my last expeditions, is in my opinion the best type of sledge yet built for polar-sea-ice work. Because of its model, this style of sledge proved much stronger and much more easy to draw than any others I have ever used.

They are two feet wide, from twelve to thirteen feet long, with a height of seven inches. The sides are made of solid oak or hickory, rounded in back as well as in front, and bent ash runners two inches wide are attached to the sides. The runners are equipped with shoes two inches wide and an eighth of an inch thick of cold sheared steel. Sealskin thongs lash the sides together, making a sledge which is strong enough to support from one thousand to twelve hundred pounds on level surfaces.

For antarctic or polar ice-cap work these sledges, while still retaining their dimensions and shape, can be materially reduced in weight by using framed construction for the sides instead of solid. The full length should be retained, as this is a great advantage and factor of safety in crossing the crevasses of the ice-cap.

The framed, or McClintock, type of sledge, with its various modified forms as used by Nansen, Abruzzi, and others, is entirely unsuited for sea-ice work with dogs. For ice-cap work, where the

ESKIMO TYPE SLEDGE

ONE OF THE PEARY SLEDGES

surface is nearly level and composed of snow and the course is straight away, or for sea-ice work, if dragged by men who will handle it carefully, the framed type of sledge has the advantage of lightness. In some of my Greenland ice-cap work I had fifty-pound sledges that would carry one thousand pounds, and twelve-pound ones that would carry two hundred pounds.

But for the grueling rough-and-tumble work with dogs on sea ice, over the pressure ridges, through rubble zones, and among the sharp-cornered ice-blocks, flinty with minus 50° or 60°F., only the solid-sided sledge will stand the racket. With it, a sharp corner of ice, coming against the side, grates and slides along until it slips off at the stern without damage, while with the framed sledge the same sharp corner will rip out three or four side posts, and necessitate a long and trying job of repairs.

Another most important feature of a sledge for sea-ice or coast work is a shoe that will bite the ice like a skate iron and not slip sidewise.

The most trying thing for sledges, dogs, and men is the side sluing of a sledge in rough ice, gathering momentum as it goes, only to bring up with a side crash against a piece of steel-blue ice. This worries and discourages the dogs by jerking them off their feet, strains the driver sometimes seriously in his efforts to soften the crash, and in my earlier sledges I have often had a side split

from end to end and bent flat under the sledge. This means unloading the sledge, work at it for two or three hours, then reloading, all in temperatures far below zero. Not until my last two expeditions did I find the material—cold sheared steel—which met my requirements for sledge-shoes.

Another absolute essential in every sledge is that there shall be no rigid joints. Such joints go to everlasting smash very quickly under the continuous succession of blows, with the entire weight of the load acting as a hammer at every impact with the flinty ice. Every joint must be lashed,—preferably with rawhide,—thus giving a certain elasticity, which eases the blow. Some expeditions have never learned this, but the Eskimos have worked it out very thoroughly, and I availed myself fully of their wonderful ingenuity and adaptation of lashings and knots for the different parts of a sledge.

There are numbers of little details in the construction of an ideal, easy-running, easy-steering sledge that are as important as the proper angle for the cutting edge of a tool in various materials, but which it would be tedious if not impossible to describe here.

This native art of sledge-building, not only the common knowledge of the tribe, but the individual knowledge of the picked Eskimos of my expedition, I was able to utilize for my sledge-equip-

ment by the simple expedient of having every man build his own sledge, material and tools of course being furnished by me. The desire to excel the other fellow, which the better men of this tribe possess, and the wish to reduce to a minimum his own personal labor and discomfort led each man to put forth every effort to make his sledge the lightest, strongest, most unbreakable, and the easiest running and most readily steered.

Thus my own practical experience of twenty years, the experience of generations of the tribe, the individual ambition and pride of my picked men, the best of material and tools, and the long hours of the winter night in which to work—all combined to give me what I have no hesitation in considering the best sledge-equipment that ever went into the field.

I also used on my last expedition the regular type of sledge which has been in use among the Eskimos since the early days when they had to depend on the bones of the walrus and whale and the antlers of the deer for material for building them. This type of sledge has two oak runners seven inches in height and one and a quarter inch in thickness. These are steel shod but are curved only at the front. To render them better adapted to the special work before us, I increased the length of these Eskimo sledges from six or seven feet to nine and a half feet.

Sledges intended for inland work differ slightly

from those to be used in sea-ice work. Deep, soft snow is generally prevalent in the interior regions, and to keep a sledge from sinking into it, it must be equipped with broad, flat runners. There can also be a decided gain in lightness in the sledges for this class of work, although the strong winds of the ice-cap carve portions of it into sharp, almost marble-like sastrugi, which tests the power of endurance of the strongest of sledges. None of those used by me in my Greenland inland-ice cap-work weighed over fifty pounds, while those used on my trip to the pole averaged ninety-five pounds.

Next after the ship, Eskimos, the Eskimo dogs, and special sledges, a vital tool for the polar explorer is the clothing for himself and the members of his party on his serious sledge-journeys. The meaning of suitable clothing on a serious polar sledge-journey goes beyond the mere personal comfort of the wearer. Fur clothing of suitable material, properly made and intelligently worn, means conservation of the vital heat and energy of the wearer, which can thus all be devoted to the object of the party, covering distance. Unsuitable clothing, as represented by the cumbersome, awkward, heavy, and ludicrous outfits of various expeditions, including some of my earliest ones, means the wastage of from fifty to seventy-five per cent. of the wearer's warmth and energy in the struggle to keep alive, leaving only from

POLAR SLEDGE COSTUME

The figure on the left has deerskin boots, the one on the right boots of muskox skin. Both have the sheepskin coat with bearskin roll about the face. The man on the right, boring a hole through the ice for a sounding, has pushed his hood back

fifty to twenty-five per cent. to be devoted to the work. A parallel illustration is that of two similar engines generating the same power but one of them consuming fifty per cent. or more of that power in overcoming its own frictional resistances, while the other uses only five per cent. for this purpose.

The former engine will have but fifty per cent. of its power for performing its work, while the other will have essentially all its power for its work, and will be able to accomplish twice as much as the first.

There is no question in my mind that if Scott and his men had had the clothing outfit of my men and had known how to wear it, the conservation of heat and energy effected by it, would, in spite of short rations, have enabled them to pull through.

The members of my later sledge-parties were normally warm and comfortable nearly all of the time, and so could devote all their energies to travel.

Nature's own insulation against cold—animal fur—and the wind-impervious integument of animal skin are the only materials for this purpose. This is nature's own protection to her warm-blooded animals living in those same regions. Once stated, the proposition is so simple as to be self-evident. If further proof were needed, there is the example of the Eskimos, whose sole clothing is fur of animals and feathers of birds.

Believing their dress perfect for conditions under which they use it, I have adopted it with slight modifications for my parties.

As so modified, the clothing outfit for every member of my party, including the Eskimos, was as follows:

One short-hooded coat of selected deerskin.

One short-hooded working-coat of selected sheep-skin.

One blanket or flannel shirt.

One pair of short, flannel-lined bearskin trousers.

One pair of bearskin or deerskin or musk-ox skin winter-weather boots. One pair of sealskin boots.

Two or three pair of polar hare-skin stockings.

One pair of bearskin mittens.

One or two pairs of deerskin or sealskin mittens.

Three or four pairs of blanket inner mittens.

Two or three pairs of deerskin inner soles.

All the material for these outfits was carefully selected and prepared, and the garments were made in accordance with the Eskimo methods, carefully fitted for each man and tried out by actual practice in hunting-trips during the winter, so that all defects were remedied before the long spring journey.

Such a clothing outfit as this reduces to the minimum the chances of frost-bite among the members of the party. A man who is normally

warm and whose blood circulates vigorously can have his hand exposed to low temperatures for a short time, as in unlashing a load or untangling the dogs, or his feet wet for a short time as the result of his getting into a lead, without having hands or feet frozen; whereas a man dressed in artificial clothing, chilly all the time, drawing on his vital heat and energy continuously, would freeze his hands or feet almost instantly under the same conditions.

Such a costume is also a very practical auxiliary of the rations in certain circumstances. When it is necessary to go on scant rations, the conservation of animal heat and life represented by one of these costumes is a very material equivalent of a considerable amount of food.

With an outfit of this kind it is possible for a party to undertake the longest of sledge-journeys in very low temperatures, and under all conditions, from sleeping in the open to the hard work of lifting and hauling the sledges over difficult places, with comparatively little discomfort.

For polar sea-ice work I consider this costume absolutely vital, because of the protection which it affords in case of falling into the leads or cracks in the ice. With the draw-string at the bottom of the coat fastened tight, with the tops of the boots tied tightly over the flap at the bottom of the trousers, a man, falling or slipping into a narrow lead, may be immersed in the water or slush to his

shoulders for two or three minutes before scrambling out, and not only not experience any ill effects, but not even have to pay any attention to the mishap. During a few minutes' immersion no water will have penetrated his fur costume; and if he is immediately scraped down with a whip-handle or back of a knife to remove most of the water or slush from the outside fur of his clothing and then, as he walks briskly along, from time to time he beats his clothing with whip-stock or knife-blade, he will have it virtually dry and clear of frost and ice at the end of three or four hours.

If he falls into a lead in such a way that he cannot extricate himself, the bulk and contained air of his fur clothing will buoy him up for a long time before the water finally penetrates it.

A sleeping-bag has always been considered an absolutely essential item of equipment for any and every sledge-party, but I have not used one since my expedition of 1891–92. My clothing outfit has served as sleeping-bag, and has enabled me to dispense entirely with that heavy, cumbersome, temper-destroying feature of sledge-work, and has permitted me to substitute on my sledges, in place of each sleeping-bag, ten or twelve additional pounds of pemmican.

For any serious sledge-journey in polar regions there are four and only four food essentials, whatever the time of year, the temperature, or the

COMPASS COURSE INDICATOR

Devised by Peary for keeping course on the great interior ice cap in thick weather and clouds. A liquid boat compass mounted on two ski at the end of a bamboo pole and pushed ahead of him by the leader of the party

PEARY SLEDGE IN ACTION

length of the trip. These are pemmican, tea, ship's biscuit, and condensed milk. Long experience with these foods as staples has convinced me that nothing else is necessary either to provide heat for the body or to build muscle. As a matter of fact, all could be omitted except the pemmican. The others, while desirable, are all from the stern polar point of view, merely luxuries.

The pemmican for my last expedition was a preparation of lean beef, dried until nearly all water was expelled from it, then ground fine and mixed with beef fat, a little sugar, and a few raisins. No more concentrated or more satisfying meat food can be prepared, and it forms the one absolutely indispensable item of any polar sledge-ration.

My hard-tack, pilot-bread, army-bread, whatever one chooses to call it, was made specially for my expedition as regards size and weight of the individual biscuit. The ingredients of the bread were essentially the same as those of regular hard-tack, being little else than flour, water and salt.

For convenience in issuing rations, these biscuit were made sixteen to the pound, which meant that, when we were on full rations, sixteen were issued to each man each day; if on half-rations, eight biscuit; if on quarter-rations, four biscuit. The biscuit were made square in the interests of reduced bulk, and they were packed in hermetically sealed,

rectangular tins containing twenty-five pounds, with each tin just as long as the width of one of my sledges, so that they stowed compactly.

These biscuit, when perfectly dry, were as sweet and crisp and fresh as any cake, and in a division of four men one tin lasted a trifle over six days. This did not give the biscuit time to become moist or soft from the drifting snow.

Our tea also was compressed to save bulk.

A daily ration of one pound of pemmican, one pound of biscuits, four ounces of condensed milk, and half an ounce of compressed tea, with six ounces of alcohol or oil for fuel, will keep a man in good working condition for an indefinite period even in the coldest of weather, and this has been the standard ration on all my polar sledge-trips.

It is policy to keep the dogs as well, if not better, fed than oneself, and one pound of pemmican per day is sufficient to keep a dog healthy and strong. When necessary, an Eskimo dog can keep hard at work for some time on very little to eat. On the other hand, an occasional double ration, if conditions permit, produces good results.

In my expedition of 1891–92 I deliberately planned to use dogs for food for the first time in the history of polar exploration. As the dogs wore out, we fed them to those remaining or ate them ourselves, thus making our load of provisions last much longer. This has been the princi-

ple of all my subsequent trips, and results have fully proved it to be a sound one.

My parties in the field have had two meals a day, one in the morning, the other in the evening. On the polar trips the party which went ahead to break a way for the main party was allowed tea and a lunch at noon, so strenuous was the work.

Essential working-tools of a sledge-party over sea ice comprise pick-axes, ice lances, snow knives, hatchets, spades, and coils of walrus line. Every one of my sledges carried a light, special double-pointed pick-ax weighing five pounds, with a selected hickory handle. When we encountered a serious pressure ridge or a zone of rough rubble-ice, the sledges stopped, the dogs lay down and went to sleep instantly, and every man in the party pulled a pick-ax from the upstanders of his sledge and stepped forward to chop a trail for the sledges through this zone of ice. This trail had already been indicated by me or some member of the party scouting in advance. As a result, trails were very quickly made.

Another very valuable instrument, used on the last expedition only, was an ice lance. There was one of these also for each sledge. Reconnoitering one day in a big second-hand military establishment in New York, I saw a lot of vicious-looking boarding-pikes. It occurred to me at once that by simply shortening and changing the shape of these

lances they would make valuable ice-cutters, and I immediately ordered several dozens. I had their shape changed somewhat, fitted them with shorter handles, and found them invaluable as an ice tool, both for cutting and chopping ice-blocks in the way of the sledges and for drilling holes in the ice.

Every sledge and every man had a twenty-inch-long saw-knife,—knife on one edge, saw on the other,—with a strong handle. These were used for repairing sledges, for chopping up pemmican, and were specially useful for cutting the snow-blocks from which our shelters were made at each camp. With every man cutting these blocks, it did not take long to erect a snow house. Hatchets are useful for ice work, for repairing, and for chopping up pemmican for the dogs.

A light, narrow-bladed spade for every four-man unit of my party was found very satisfactory in building igloos.

My firearms outfit comprised two Winchester 40–44 carbines, each weighing only a trifle over five pounds, with magazines carrying ten or eleven cartridges. These rifles are heavy enough for seals or polar bear, the only game there was any chance of our encountering on the ice. They were carried pistol fashion in a canvas holster at the upstanders of the sledges, so that if game was sighted, there was no delay. One had simply to snatch the rifle out of its holster and use it.

Every member of the party had a pair of snow-

shoes. Snow-shoes may be a life-preserver for a man in sea-ice work in enabling him to cross young ice which would be absolutely impossible without them. Members of my party had snow-shoes six feet long and a foot wide. The Eskimos' snow-shoes were five feet long and a foot wide. All were made by Dunham of Norway, Maine, the best snow-shoes I ever saw.

Another important item of equipment on my last sledge-journey was an entirely new alcohol-stove of my own design, which I spent hours in perfecting and trying out during the long winter night. This new device worked splendidly, enabling us to melt ice and make tea in ten minutes, a process which had on previous trips, with the old style stoves, taken a full hour. A saving of something over an hour and half every day on a long journey over the sea ice may mean the difference between success and failure. The hour and a half thus saved can either be utilized for sleep to keep the members of the party more fit under the severe strain to which they are subjected; or it can be utilized for traveling, with a resulting increase in the distance covered in each march.

The instrumental outfit for a sledge journey of any length should include a theodolite, a sextant, and artificial horizon, compasses, chronometers, thermometers, a good field-glass, cameras, and, for sea-ice work, a light sounding-equipment. The

theodolite we carried on the north-polar trip was a small traveler's, made by Fauth & Company of Washington, D. C. It was equipped not only with a tripod, but had an arrangement by which it could be mounted on its case for use when the wind was blowing hard enough to make the tripod too vibratory to be practicable.

The sextant and artificial horizon were of standard pattern and the artificial horizon was of special form designed by me expressly for this journey, with a wooden trough and a different method of returning the mercury to the bottle, the entire equipment representing a reduction of some pounds in weight from the standard mercurial horizon as furnished by dealers.

Our chronometers were made by the E. Howard Watch Company of Boston, the Elgin Co. and the Waltham Co. They were pocket-size, open-face, stem-winders, kept good time, were light in weight, easy to read, and were worn suspended by a cord round the neck inside our clothing.

Binoculars were the Academic Optiques, aluminum, and extremely light; thermometers were supplied by Green of New York, being the regular maximum and minimum self-registering kind; and cameras were the Eastman Kodaks No. 4, with rolls of twelve negatives each, daylight reloading.

The sounding equipment was new on this expedition, never having been taken on previous trips, and consisted at the start of two thousand fathoms

(twelve thousand feet) of specially made steel piano wire in two reels of a thousand fathoms each, the net weight of each reel being twelve and a fraction pounds. The sounding-lead was cut down from its original weight to a final weight of about fourteen pounds, and had at the lower end an automatic clam-shell device for bringing up samples of the bottom.

The sounding wire was marked in one hundred fathoms by bits of brass soldered to it, and was wound round a wooden reel that could be attached temporarily either to the front or rear end of a sledge for making soundings, and then, by the attachment of cranks at both ends, the wire could be reeled up again when the sounding had been completed.

Some five hundred fathoms of this were lost by breaks in the earlier part of the trip north, but when Bartlett left me there were some fifteen hundred fathoms left, and fearing to lose more of it, I did not attempt to make any more soundings until just south of the pole on the return trip. It was fortunate that I did this, as in making the sounding the mishap which I had feared occurred, resulting in the loss of all but a hundred or two feet of the wire and making it impossible for me to make further soundings on the return trip, as I had planned, to supplement those made by Marvin and Bartlett.

The one sounding, however, showing that the

central polar ocean is probably not less than two miles in depth, is of pronounced interest to the geographer and oceanographer.

Our instruments were all kept in a special instrument box. This was a milk case covered carefully with canvas to keep the fine snow from being blown into it, and reinforced with tin on the corners to withstand rough usage on the trip. The sextant was suspended from the cover of the box to protect it from shocks.

The instrument box was always stowed on the middle of the special sledge used to carry such equipment, where it would get the least motion and pounding, and rested on a cushion of spare clothing.

The theodolite, in its box, was carried in a canvas case in front of the upstanders of the sledge, resting on some item of spare fur clothing, and kept in place by elastic lashings of rawhide line.

The camera, thermometers, note-books, field-glasses, and Winchester carbine were carried in canvas pockets by the upstanders of the sledge, and arranged in such a way that any one of them could be obtained instantly for use without having to unlash any portion of the load.

CHAPTER X

SLEDGE-TRAVELING

SLEDGE-traveling is the other twin of ice navigation, the two together forming polar exploration. The purpose of sledge-traveling is the transformation of food into miles, and the test of its perfection is the maximum number of miles for the minimum amount of food. Sledge-traveling may be of several kinds. It may be over the frozen surface of polar seas, or along a coast line, or over the elevated snow surfaces of the great interior ice-caps of Greenland and the antarctic continent.

In the attempts to reach the north pole the first of these methods was among the first to be attempted, the effort to sledge north from a ship. Then the second came into favor. The fourth method was the last to be exploited, and in this the writer feels he has some claim to having developed a new departure in polar sledging, through his years of Greenland ice-cap journeys.

In considering the two great prizes of polar exploration, the north pole and the south pole, the attainment of the former was dependent upon pro-

ficiency in sledging over the surface of a polar ocean; while the latter—in fact all antarctic sledge work—is of the fourth kind, the traverse of the continuous permanent interior ice-cap of the antarctic continent.

Still considering these prizes, the great distinction and contrast between north polar and south polar sledge-traveling must be clearly and constantly borne in mind. In the north polar game the last stage of the journey—from 500 to 600 miles, according to the route selected, whether Grant Land or Greenland or Franz-Josef Land—is over the frozen surface of the Arctic Ocean. This ocean breaks up every summer, the great fields of ice drifting under the influence of wind and tide to an eventual exit into the North Atlantic; and at any time of year, even the depth of the severest winter, a storm will rift the icy surface in many places with cracks and lanes of open water, and throw up great ridges of ice-blocks by the pressure of the ice-fields. No place on the frozen surface of the ocean can be counted upon to be in the same locality a month later.

From these facts result the following fundamental circumstances in north polar sledge-travel: first, that the sledge-journey must be undertaken in the very coldest part of the year, so that the sea ice may be most firmly cemented together, and that open water, if it does appear, may be most quickly frozen over again by the extreme cold.

Second, that no caches or depots of provisions can be deposited on the outward journey, to be picked up on the return, thus lightening loads and increasing speed, because there would not be one chance in ten of ever finding them again. Everything used on the journey, therefore, must be carried the entire distance, and the objects of the journey must be accomplished within the limits of a single sledging season, from the time a little light returns in February to the breaking up of the ice in June, or the whole thing must be done over again.

The average layman will probably consider the first of these conditions, the extreme cold, as the most serious. As a matter of fact, the second is the most vital, and is the one which has caused the discovery of the north pole to drag along through hundreds of years, while the south pole was attained twice within thirteen years after the first sledge-journey in that region.

In the south polar game the last stage of the journey—from 700 to 800 miles—is over the eternal surface of the glaciers and the interior ice-cap. On this surface a depot of provisions put down to-day will be found in the same place to-morrow or next month or next year or ten years from now. From this fact result unique and ideal conditions for the establishment of caches to any extent desired, so that a returning party may come dashing back the entire distance with nearly empty

sledges. A journey of any length in that region is only a matter of time.

Second, sledge-travel in the antarctic can be carried on in the summer season of greatest warmth and continuous light.

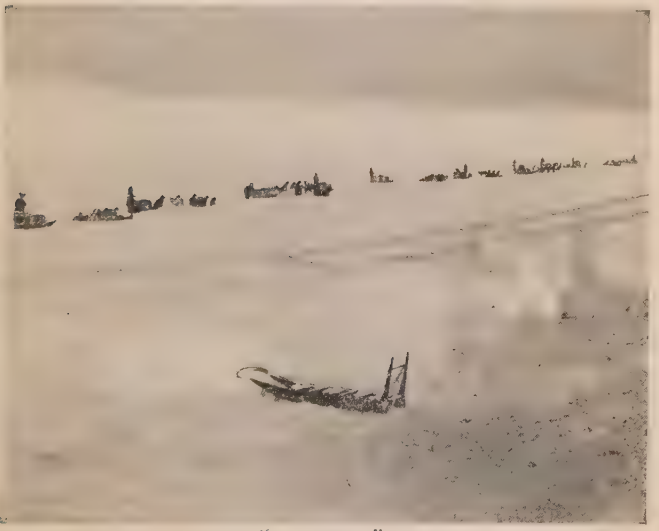
On the other hand, sledge-traveling to the south pole encounters the serious disadvantage of the pronounced altitude, 10,000 to 11,000 feet in the last stages of the journey, with its decrease in efficiency in men, dogs, or ponies.

My knowledge of conditions to be encountered in overland sledging was gained in numerous short trips in Greenland and two long journeys of 1200 miles each across northern Greenland's ice-cap, the "inland ice."

To the average reader the expression "inland ice" suggests a surface of ice. This idea is erroneous. Greenland is a great glacial country, with an area of 740,000 or 750,000 square miles, fully four fifths of which are covered by the inland ice, the only portion of it that could be called land being a ribbon of mountains, valleys, and deep fiords along the coast. This narrow strip of land is for the most part from five to twenty-five miles wide, but there are several places where it is sixty or eighty miles.

The interior of Greenland, or the inland ice, is so cold that it gets virtually no rain, and the snow does not have a chance to melt in the long summer day. So the snow has accumulated century after

HUGGING THE SHORE TO GET AROUND HUGE ICE FIELDS
Note the yacht-like lines



PARTY LEAVING THE "ROOSEVELT" FOR CAPE COLUMBIA

century until it has filled the valleys, and not only leveled them with the tops of the mountains, but the highest of these mountain-tops have been gradually buried hundreds and even thousands of feet deep in ice and snow. To-day the interior of Greenland, with its 1500 miles in length and some 700 miles in maximum width, rising from 4000 to 9000 feet or more above sea-level, is simply an elevated and unbroken plateau of compacted snow.[1]

[1] Greenland is the largest island in the world. Its total length from Cape Farewell, its southern extremity in 60° N. latitude, to Cape Morris K. Jessup, its northern extremity in 83½° N. latitude is in round numbers 1500 miles, almost exactly the same as the length of the United States on the 97th meridian, from the mouth of the Rio Grande to where our northern boundary crosses the Red River of the North. The greatest width of Greenland is about the same as the distance from New York to St. Louis.

In regard to its area, the figures of various authorities vary widely. It may be sufficient to say that as regards area it can be grouped in size with the United States east of the Mississippi; Alaska; Mexico; Columbia; Persia; Portuguese West Africa; Turkey in Asia. Its interior is covered with a great sheet of ice rising to elevations of probably 10,000 feet in places and several thousand feet in thickness. The available ice-free land is a strip of varying width along the coast, intersected by numerous deep fiords.

Geographically, Greenland belongs to North America and the Western Hemisphere, over which we have formally claimed a sphere of influence by our Monroe Doctrine. Its possession by us will be in line with the Monroe Doctrine, and will eliminate one more possible source of future complications for us from European possesson of territory in the Western Hemisphere. Will turning Greenland over to Denmark now mean our repurchase of it later, or will obtaining it now mean closing the incident and placing Greenland where it must ultimately belong?

Greenland is comparatively near to us. For years American ships have conveyed cryolite from the Ivigtut Mines to Philadelphia. There is coal and cryolite, probably graphite and mica, possibly gold, in its rocks. Danish capital has apparently not been sufficient to exploit the country's resources. With our un-

On this great frozen Sahara of the North the wind never ceases to blow. It invariably radiates from the center of the ice-cap outward, blowing perpendicularly to the nearest portion of the coast land, except when storms of unusually large proportions sweep across the country. Such a regular thing are the winds of these regions, and so closely do they follow the rule of perpendicularity to the coast, that it is always easy to determine the direction of nearest land. A sudden change in

limited means, it may, like Alaska, prove a sound and most valuable business investment.

The abundance of native coal and the numerous glacial streams which come tumbling into the southern fiords from the great interior ice sheet represent enormous potential energy, which might be translated into nitrate and electrical energy, to make Greenland a power-house for the United States.

Greenland represents ice, coal, and power in inexhaustible quantities. And stranger things have happened than that Greenland, in our hands, might furnish an important North Atlantic naval and aeronautical base.

A North Pacific naval base for the United States in the Aleutian Archipelago is a recognized possibility. Why not a similar base in the North Atlantic? Cape Farewell in Greenland is but little north of Sitka. It is in the same latitude as St. Petersburg; Christiania, Great Britain's naval base in the Orkneys, and the northern entrance to the North Sea, which Great Britain has incessantly patrolled with her war-ships summer and winter for two years.

There are fiords in southern Greenland which would hold our entire navy, with narrow, deep water, impregnable entrances.

Thirty-hours steaming due south from Cape Farewell by thirty-five-knot war-craft would put them in the transatlantic routes midway between New York and the English Channel.

With the rapid shrinking of distance in this age of speed and invention, Greenland may be of crucial importance to us in the future.

—From Peary letter, September, 1917, suggesting Denmark give the United States Greenland with the Danish West Indies.

the wind indicates the presence of large fiords, and the crossing of a divide can be detected by the area of calm or changeable winds which prevail, and which are followed by winds blowing from the opposite direction.

Sweeping along the most direct path to the coast, and with greater or less velocity, the wind always carries with it a flying mass of snow, which, on reaching the mountains, settles in the valleys or goes swirling over the cliffs into the sea. When there is only a light breeze the snow is very fine and flies only a few feet in the air; but the stronger the wind, the coarser the whirling snow becomes, and the greater the depth of its current. In blizzards on this desert of snow this drift surpasses in fury the sand-storms of the African Sahara, the snow rising in the air hundreds of feet in hissing, roaring, blinding torrents, which make it almost impossible for one to breathe, and which bury anything stationary in a short time. It penetrates like water, and on stepping into the drift its surface is very nearly as tangible and sharply defined as that of a pool of water of like depth.

The continuous transportation of vast quantities of the snow by the wind is a most important factor in retarding the increase in the depth of the ice-cap, and in my opinion is a factor equaling possibly the effects of evaporation, melting, and glacial precipitation all combined. Only investigations carried on for a period of years can defi-

nitely determine whether this snow deposit is increasing or decreasing as the years pass.

Undoubtedly the coldest spot in the world is to be found in the center of the great ice during the polar night, where at an altitude of one or two miles it gets the full benefit of the frigid polar air; is several hundred miles from the polar seas, and is insulated by a mile or more of ice and snow from any radiation of heat from the earth beneath.

During the winter months the whole surface of the inland ice is covered with a layer of fine, dry snow. The noonday sun of the late spring causes the snow along the edge of the ice to become soft, and the freezing of this at night makes a thin crust. As this layer of crust creeps into the interior with the approach of summer, the snow on the edge of the ice-cap turns to slush and finally melts, forming pools and streams which eat into the ice, opening up old crevasses and new ones as well. This condition likewise extends into the interior in the wake of the crust and the summer heat, and eroding streams, working on the border of the cap, make it so rough as to be in places quite impassable.

Traveling into the interior for fifteen or twenty miles, one finds that the mountains along the coast have quite disappeared under the landward convexity of the ice-cap, and the surface, which near the coast is composed of many hummocks, gradu-

ally merges into long, flat swells, which in turn merge into a gently rising plain and finally into a level surface.

In my journey across the ice-cap of northern Greenland in 1891 I was continually turned from my course on the upward march by numerous crevasses and steep slopes which occur along the edge of the inland ice. These crevasses sometimes cover a tract several miles wide, and are usually marked by peculiar ice-mounds two or three feet in height. Covered with a light crust, the crevasses are difficult to detect, and one must be constantly on the alert to avoid getting into them. At times it is necessary to reconnoiter for hours before safe snow-bridges across these treacherous places can be found, and on several occasions I nearly lost all our provisions and dogs when the sledges broke through.

Determined to avoid such conditions on the return trip, I traveled well inland. Here, however, deep, soft snow makes sledge-traveling difficult; so on my second journey across Greenland, in 1895, I chose an intermediate route, hoping to avoid crevasses and slopes and slippery ice as well as soft going. This route proved to be by far the best one, the surface being much better, and the distance a few miles less than by either of the other two routes.

In addition to the wind there is another peculiarity of the inland ice which adds to the diffi-

culties to be encountered in this work. That is the extreme intensity of the sunlight, which can be realized only by those who have experienced it. During the summer months the sun shines continuously, and this continuous brilliancy is intensified a hundredfold by the reflection from endless fields of glistening, sparkling snow, unrelieved by a single object. The strongest eyes can stand such a blinding glare only a few hours without protection. We always wore heavy-smoked glasses, and when in camp found it impossible to sleep without still further protecting our eyes by tying a narrow band of fur about them to exclude the light. Only when a storm is brewing does this intense light become subdued. At such times, however, the sky and snow take on a peculiar gray, opaque light which is even more trying than the sunlight.

To direct a course across unbroken fields of snow, with absolutely nothing to guide or fix the eye, is a task which requires a good deal of experience. And to force a team of dogs dragging a heavy sledge-load into blank nothingness is still more difficult. During dull or foggy weather the work of keeping a direct course becomes particularly arduous. For days I have traveled into gray nothingness, feeling, but unable to see, the snow beneath my snow-shoes, and the long days and nights of marching when it was almost impossible to see the length of the sledge were among

the most trying experiences I had on the inland ice.

On both my journeys across the ice-cap I was accompanied by only one man, and with compass in hand one of us would take the lead, go ahead as far as it was possible without losing sight of the party, (and at times this would be only a matter of a few yards), put himself on the course, and then wait for the other to come up with the dogs and sledges. At other times we devised a wind-vane and used the wind as a guide, taking a compass direction of it every quarter- or half-hour, keeping the wind-vane at the proper angle, and in this way making a fair course. The endeavor to keep a direct course for any length of time under such conditions imposes such a strain on mind and body that travel sometimes becomes impossible. In addition to this, the feeling of fatigue and heaviness which are the result of the fog and altitude make traveling still more difficult.

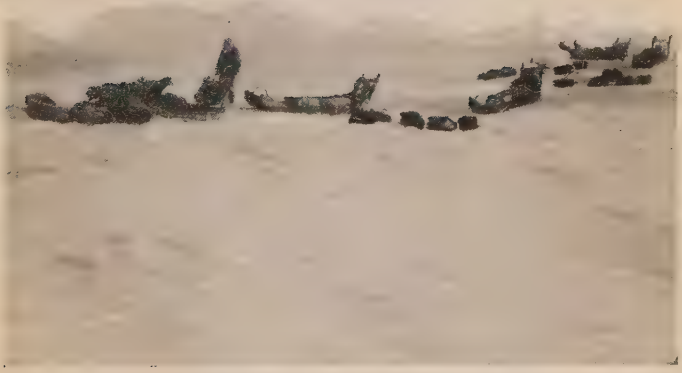
A severe and protracted storm is one of the most disagreeable features of sledge-traveling whether over land or sea ice, and preparations should be immediately made to camp as soon as one is seen to be approaching. If the equipment does not include a tent, a snow igloo should be built as quickly as possible. If there is not time for this, then a dugout can be made in a snow-bank or a snow-wall erected as a shelter from the wind and driving snow. Everything possible should be

carried inside the tent or igloo, and the dogs securely fastened outside. Storms on the ice-cap are so severe that, when possible, the dogs should be protected from them by a snow-wall. I have been confined to tent or igloo for days at a time by these storms, but the most accursed hours I ever spent on the ice-cap were those spent in a small tent six long days and nights, five thousand feet above sea-level, during a furious storm which I knew was destroying my last chances for finding a ton and a half of supplies, including all my pemmican and alcohol, which I had cached the year before for my spring work in 1895.

Any one seeing our camp at the end of one of these storms would believe us buried alive, the only signs of our presence being the snow-mounds covering us and the dogs.

One storm will play more havoc with the dogs and their harnesses and traces than the work of two weeks' continuous traveling. To get the sledges and the dogs and tent dug out, to say nothing of untangling and repairing the dogs' traces, which become terribly twisted and tangled, is enough to keep two men busy for hours. After almost every snowfall we had to help the dogs drag the sledges. For this purpose a long line of walrus hide was tied to the front of the sledge, running out over the dogs, so that one of us could attach it to our shoulders and pull in advance of the team. To the side of the sledge a

OVER A PRESSURE RIDGE



A HALT ON THE MARCH

short line was fastened enabling the other man to pull and drive the dogs at the same time. Dragging the sledges through soft snow is very disheartening work for the dogs, and every expedient that ingenuity can devise or that is known to the Eskimos must be used to urge them forward. Only one thing can make traveling harder on the inland ice, and that is a precipitation of frost, which, covering the surface like sand, makes the sledges drag like so many loads of lead. Dogs that in ordinary going can haul two sledges at a fair rate of speed require the combined assistance of two men to move one. For this condition of snow even icing the runners seems to do but little, if any, good.

This process of covering sledge-runners with a coating of ice, taught me by the Eskimos, is most interesting, and wonderfully increases the tractive power of a sledge in low temperatures.

A long strip of thick walrus skin, which, when frozen, is the toughest and most unbreakable of all substances, the same width as the runner and from which the hair has not been removed, is first applied to the bottom of each runner, being fastened by lashings of rawhide run through slits in the edges of the walrus hide. After this has been allowed to freeze solid the entire length of each runner is covered with soft snow which has been dipped in warm urine. This is pressed and shaped with the hand until it is three-quarters of

an inch, perhaps an inch, thick. When this has been given time to freeze solid it is chipped and made smooth with the aid of a knife, and rubbed over by hand with water. As the dogs get tired and the going becomes harder, the ice coating on these shoes should be renewed nearly every day on inland ice cap-work. The effect of high elevation is very perceptible upon men and dogs, and it is difficult to force dogs to go faster than at the rate of two miles an hour. At such times we iced the sledge-runners twice a day.

The routine on our long marches was for the most of the time about as follows: The work of caring for the dogs, harnessing them in the morning and unharnessing and tying them to stakes at night and feeding them at the end of the day's march, was my special work. During the march my companion took charge of them while I kept the course, except when to vary the monotony we exchanged duties. My companion always built the snow shelter at night which served as a kitchen, and we took turns acting as cook. The man on duty in the kitchen slept there all night, and stood ready to re-secure any dogs which might break away during the night.

In my first trip across the ice cap of Greenland I used a considerable number of Eskimo dogs which had just been purchased from the natives and were entirely unacquainted with us and we with them.

Naturally our unusual size, strange complexion and stranger language were at first a source of terror to them and in the earlier stages of the journey when a dog got loose at night it was sometimes quite an effort to secure him again. Before the journey was over we had no trouble with any of our dogs.

Other parties using Siberian dogs for the first time may have the same experience.

To catch a loose dog sometimes requires more or less time and ingenuity and may result in a few bites. Our usual method of capturing one of these polar wolves was to coax him within reach by throwing out morsels of meat to him, then throw ourselves upon him and quickly bury his head in the snow. We soon became expert enough in this to avoid more than a few bites. Sometimes a dog is too wily to be caught in any such way and has to be lassooed and choked almost senseless before he can be put back in harness.

Up to 1895 the basic principle of polar sledging was that overland traveling was not practicable, that the only highway lay along the sea-ice off the coast. Therefore the journey I mapped out—the crossing of the inland ice-cap of northern Greenland—was an unprecedented one in point of distance to be covered without caches or supply depots. The successful carrying out of this plan has shown the practicability of the inland ice for a road, and since that time

Greenland has been crossed by Nansen and Spitzbergen by Conway. The capabilities of overland traveling having been about exhausted in 1895, the invaluable experience gained in my Greenland work was concentrated upon a persistent effort to solve the polar question.

In this connection the following grouping of material may be of interest:

"My comprehensive scheme for work in Greenland, based upon the utilization of the Inland Ice for overland sledge journeys, and my subsequent development and execution, in actual practice, of methods, means, and details, justify me, I think, in claiming to have originated a new departure in Arctic work. Since my origination of that departure, Nansen has crossed Greenland; Conway has crossed Spitzbergen; and if our present idea of conditions in the Antarctic be correct, *it is entirely within the possibilities, that the conqueror of the South Pole will achieve success by adopting my methods and equipment.*"—Peary in "Northward Over the Great Ice," 1898, Vol. I, page lvii.

"The North Pole is reached."

In a flash the news spread over the world. The goal of which so many had dreamed, for which so many had labored and suffered and sacrificed their lives, was attained. It was in September, 1909, that the news reached us.

At the same instant I saw quite clearly that the original plan of the *Fram's* third voyage—the exploration of the North Polar basin—hung in the balance. If the expedition was to be saved, it was necessary to act quickly and without hesitation. Just as rapidly as the message had traveled over the cables I decided on my change of front—to turn to the right-about, and face to the south.

The North Pole, the last problem but one of popular interest in polar exploration, was solved. If I was not to succeed in arousing interest in my undertaking, there was nothing left

SLEDGE PARTY ON THE MARCH WITH GOOD GOING

HARD GOING

for me but to try to solve the last great problem—the South Pole.

The British expedition was designed entirely for scientific research. The pole was only a side-issue, whereas in my extended plan it was the main object.

If Peary could make a record trip on the Arctic ice with dogs, one ought, surely, with equally good tackle, to be able to beat Peary's record.—Amundsen in "The South Pole," 1913.

My despatch telling of the discovery of the north pole was dated September 6, 1909. Amundsen sailed for the south pole in June, 1910. In the nine months before that time the details of my work were known everywhere. In Amundsen's journey to the south pole he used dogs exclusively for traction; pemmican was his mainstay for food; his clothing was fur; he had one object, the south pole.

Many are under the impression that the ice of the polar sea is smooth as glass and that explorers simply ride to their destination on dog sledges. In reality the only smooth ice to be found is while still on the glacial fringe, an ice-foot which extends along the northern coast of Grant Land and Greenland, varying from one-half to five miles in width. Parts of the outer edge of this fringe rise and fall with the tide, and sometimes large areas of ice will separate from it and float off to sea, but as a body it is stationary. Outside the fringe is a shore lead, or tidal crack, which opens under the stress of offshore winds or ebb-tides in the spring, and shuts under

the effect of northerly winds and spring-flood tides. The constant battle which occurs here between this glacial fringe and the heavy, detached floes smashes the ice into all shapes and sizes, and piles it up in great pressure ridges which may be a few feet or a few rods high and several rods or a quarter of a mile wide.

Farther out huge floes are hurled against one another by the wind and tides, thus forming more pressure ridges. Between these series of ridges old floes are found which at times are comparatively smooth.

The ice of the polar sea during the summer is constantly moving, large fields of ice ranging from ten or fifteen to over one hundred feet in thickness, break away from glaciers, crushing the thin ice and smashing against other fields, splitting them and forming new ridges until the surface, when it again hardens in the winter, is simply a chaos of broken ice. Nine-tenths or more of the distance between northern Grant Land and the pole is composed of these floes, the rest being ice, formed by the sea-water freezing during the autumn and winter months.

Continued northerly winds during the autumn, when the masses of ice are gradually freezing together, will force the heavier ice toward the shore while farther out the edges of the ice-floes where they meet pile up in regular series of ridges. If, however, the winds are not strong during the au-

tumn many large ice-fields separate from other floes, and between these masses of ice new ice, fairly smooth, and never over eight or ten feet thick, will form. This remains until summer unless violent winds occur to crush it up.

The difficulties and hardships of travel over these ragged and mountainous pressure ridges must be experienced to be appreciated. A trail oftentimes must be hewed out with pick-axes, and the heavily loaded sledges pushed, pulled, hoisted, and lowered over the hummocks and steep acclivities, even unloaded, and the equipment carried over on one's back. On our return from farthest north in 1906 we encountered a seemingly endless and indescribable chaos of broken and shattered ice at the place where we had been held up by the big lead on our upward march, and it took hours of grim and exhausting work to carry us through it.

Bad as the pressure ridges are for sledge-traveling, however, they are not as dangerous or trying as the lead or lanes of open water caused by the action of wind and tides on the ice. These are in some cases mere cracks running across the floes in almost straight lines. In other cases they take an irregular course across the ice, and are just wide enough to prevent crossing. Again they will be as large as rivers, a mile or two wide and many miles long. For a polar-sea explorer these leads are an omnipresent nightmare.

When or where they will occur is impossible to tell. It may be with a loud report directly ahead of a party, cutting off their advance northward or cutting off their return to land on the way back. It may be directly in the midst of camp. With every northward march on my last two sledge journeys fear of impassable leads increased, and I would find myself hurrying toward every pressure ridge, fearing it concealed a lead beyond it. Arriving at the summit and finding no lead ahead, I would catch myself hurrying on in the same way at the next one.

The best way to cross wide leads is learned only by long experience. Sometimes a detour east or west will result in finding a place narrow enough to permit long sledges to be bridged across. In very cold weather it may be found practicable to wait until new ice forms thick enough to allow a sledge to be rushed across, or a lead may show signs of closing, in which case a party can wait until it is quite close together.

Occasionally large pieces of floating ice are to be found in a lead, forming a sort of pontoon-bridge across it. One member of the party goes ahead to pick the way, jumping from one cake to another, and making sure the weight of dogs and sledge will not tilt the cake, then encouraging the dogs to go forward while the driver of the sledge steers it and at the same time balances the cake of ice to keep it from overturning.

To make dogs leap across a widening crack is work which requires an expert dog-driver. Some can do it without any trouble by use of the whip and voice, others have to go ahead of the dogs and coax them to make the jump by holding their hand low and making a pretense of shaking a morsel of food. Leads which are too wide to jump the dogs and sledges across can be ferried by hacking out a cake of ice large enough to bear the weight of dogs and sledges. It sometimes happens that in crossing a narrow lead it will open before the entire party has crossed. This occurred on my last trip north, an Eskimo with his sledge and dogs being left on the other side. An impromptu ferry-boat was cut out of the ice on our side of the lead, two coils of rope were fastened to each other, and slipped around the cake. Two Eskimos boarded it; a line was thrown across the lead to the other Eskimo while one on our side held that end. Then the two men on the ice-cake took hold of the rope and pulled the raft across the lead. The dogs and sledge and other Eskimo were taken upon the ice-cake, and we hauled them across to our side.

Leads which assume the proportions of rivers, such as the one we encountered on the way north in 1906 and on our way back the same season, are a different matter, and the only thing one can do is to wait until young ice forms strong enough to afford a passage.

To know how to travel safely over young newly formed ice is one of the most important items of knowledge and training for a polar explorer. Prof. Marvin of my last expedition was drowned by breaking through young ice while returning in command of one of my supporting parties, and one of Captain Cagni's supporting parties was totally lost in the same way.

Members of my expedition had frequent narrow escapes in spite of every precaution, and my entire party had a very close call in 1906 while crossing a two-mile wide stretch of extremely thin ice. Only the utilization of every known trick and method brought us through in safety.

That there were not more fatal accidents was due largely to my previously gained experience and the careful and repeated training and cautioning which my men received.

Snowshoes are a most necessary adjunct of such travel. The distribution of a man's weight effected by a good pair of six-foot snowshoes will enable him to travel safely over ice which would not support him for an instant without them.

The Eskimos of Whale Sound as a result of their seal hunting on newly formed ice in the autumn, and their spring walrus hunting on young ice at Cape Chalon, have the art of traversing thin ice down fine.

They need to. It is often a matter of life or death to them.

When young ice is encountered which sinks and buckles under the feet at each step, the first precaution is to spread the feet—travel wide—and slide them along as evenly and rapidly as possible without lifting them from the ice.

The Eskimos say that the polar bear does this when stalking seals on thin ice. If this is not enough the next move is to get down on all fours with both hands and feet spread wide apart and then shuffle along without lifting hands or feet from the ice.

When an Eskimo does this in the seal hunt, he usually has his seal-spear in one hand and his lance in the other, both extended on the ice and sliding with the hands.

The distribution of weight resulting from this is very effective.

With the polar explorer two ice lances form a good substitute for the Eskimo spear and lance.

The final position is to lie flat with arms and legs extended and squirm and wiggle slowly along. If two pair of six-foot snowshoes are available to still further increase the bearing area and distribute the weight, it is possible to negotiate surprisingly thin ice.

Bartlett on his remarkable retreat from the crushed and foundered *Karluk* in Bering Sea, would never have made his astonishing traverse of the more than a hundred miles of thin moving ice in Long Strait between Wrangel Island and

the Siberian coast, but for his experience and training with thin ice while with me.

Nor would he have brought his crew to Wrangel Island in safety but for his extended experience with me in negotiating the apparently insuperable pressure ridges of the polar ocean.

The authority for these statements is Bartlett.

Low temperatures, ranging anywhere from twenty to sixty degrees below zero, keeping a party's brandy solid; having to march all day in the face of a blinding snow-storm, with the wind piercing every opening in the clothes, and then having to build an igloo for shelter at the end of the day, are other hardships. During some sledge journeys the wind scarcely ceases to blow for an hour. Its infernal rush and assault cuts and blisters faces and sets eyes stinging with pain, and at the end of every day's march in the field faces are rubbed with vaseline, and sometimes wine of opium applied to the eyes.

Another ever-present danger in sea ice-work is that of breaking through young ice and getting wet. A mishap of this kind is to be dreaded, for even if a man is able to get out of the water quickly he would soon freeze in such low temperatures with no igloo and change of clothes at hand.

For a sledge-journey of any length across the polar sea the method of advance and supporting parties has proved the most effective. A pioneer party was introduced for the first time in my

CROSSING NARROW LEAD

THROUGH A CAÑON OF THE POLAR OCEAN

work, and while supporting parties had been used before in polar work, they had never been utilized on such a scale as on my last expedition.

The pioneer party was made up of four experienced and energetic men, with lightly loaded sledges and the best dogs in the pack. This division left Cape Columbia under the leadership of Bartlett twenty-four hours ahead of the main party. In all kinds of weather and regardless of every obstacle except impassable leads, a march was to be made every twenty-four hours (later when the sunlight was continuous during the twenty-four hours the advance party kept only twelve hours ahead of the main division), breaking the way and in fact setting the pace for the main party, which, having to waste no time in choosing and breaking a trail, could cover the same distance as the reconnoitering party in less time, even with more heavily loaded sledges. Bartlett traveled ahead of his division, usually on snow-shoes, picking a trail. My main party was large enough to permit the withdrawal of the men from the advance party to the main party as they became exhausted by the hard work and lack of sleep; and the sending out of fresh men to continue the work. This enabled me to conserve the strength of those who were to make the final dash for the pole.

The advantages of supporting parties cannot be too strongly emphasized. It is impossible for

a party, either large or small, to drag food and fuel enough to sustain life in themselves and their dogs for a distance of some nine hundred miles across the polar sea. Just as soon as a party consumes the provisions of one or two sledges the drivers and dogs, (being just so many superfluous mouths), should be sent back to headquarters with their empty sledges. When another sledge-load or two of provisions have been depleted, their drivers and dogs should likewise return. In all, four supporting parties were sent back one after another, the last one in command of Captain Bartlett, leaving me near the 88th parallel. Up to this point I had traveled in the rear of my party to see that everything was going smoothly. On sending back Bartlett's division, however, I took my place at the head of the party which was to make the final dash. This was of necessity a small group and most carefully chosen, consisting of Henson and four of my best Eskimos.

The second important duty of the supporting parties is to keep the trail open so the main party can return rapidly. That this is no slight consideration is shown by the fact that in twenty-four hours or sometimes in twelve hours the fierce winds of the North will start the jamming of the ice-floes, throwing up pressure ridges and causing leads. Ordinarily, though, the ice will not change much in eight or ten days, and a party

returning follows the outward trail, patching up any faults or breaks which have occurred in it since it was broken. The next party, returning a few days later from a point still farther north, knits together the broken places in its own trail, and, coming to that of the first returning party, smooths over any breaks which may be found. The next party does the same, and so on until the main party on its return has simply to follow the trail of the supporting parties instead of having to reconnoiter and make a new one. With no trail to make and the dogs eager to follow a beaten track leading homeward, the speed of the main party on my last expedition was greatly increased on its return march, the upward journey having been accomplished in twenty-seven marches while the return was made in sixteen. In addition to the advantage of having a well broken trail to return by, the returning division uses the snow igloos which were built on the way north, thus saving time and energy which the building of a new igloo at the end of each long march would mean.

As far as the polar dash was concerned, the work of each supporting party was finished as soon as it reached land. Each of these parties, consisting of four men, was entirely independent, having its own provisions and a complete traveling outfit. With the exception of the kitchen box containing the alcohol-stove and cooking-utensils,

each sledge was complete. In the event of a mishap and the loss of the cooking-outfit, the division losing it would have to double up with another division.

The number of miles covered in each march was first determined by dead reckoning; that is, by taking the compass course for direction and the mean estimate of Marvin, Bartlett, and myself for distance traveled. At intervals of several days this was verified by observations for latitude, and proved to be satisfactorily approximate to the results obtained by our astronomical observations.

For tractive power I have always used the Eskimo dogs, and believe they are the *only* motor for polar work. Eight dogs are required to haul the standard load, but with an extra load or for fast traveling I have sometimes used ten or twelve good dogs. The dogs are attached to the sledges fanwise, the king dog of the team taking the lead, and there is no peace among the dogs of each team until it has been definitely settled among themselves which animal is the best or strongest of the lot. The Eskimos make their harnesses of sealskin, but when the dogs are living on short rations they will eat anything made of this material, and to prevent this I have used a special webbing or belting two and a half inches wide. Instead of making the traces of raw-hide, as the Eskimos do, I have substituted braided

linen sash-cord for it. My dog harnesses were made on the same pattern as the Eskimos', two loops of belting, through which the dog's forelegs pass, attached by a cross strip under the throat and another back of the neck. The ends of the loops are brought together over the middle of the dog's back, and the trace fastened to them, making a flexible harness which will permit a dog to pull to the full extent of his strength without cramping or chafing him. The art of guiding a team of lively Eskimo dogs by the voice and rawhide whip twelve or eighteen feet in length is something which requires long time and great patience to master.

Other explorers, British and Norwegian, have smacked their lips in the pages of their narratives and reveled in their "hoosh" and pemmican stew, even though there were lumps of ice in it. In all my expeditions after the first one, when some members of the party made themselves sick by eating too much pemmican stew, no attempt has been made at cooking or even warming the pemmican ration. It has invariably been eaten like a piece of cake or pie, just as it came out of the tin. In this way much economy of time and fuel has resulted.

Pemmican is the most satisfying food I know of. Many times I have reached camp feeling as if I could eat my own weight, and the one half-pound ration of pemmican has seemed painfully small.

But by the time I had finished I would not have gone out of the igloo for the finest spread New York could furnish.

The snow house, or igloo, of the Eskimos has a value and a meaning in the scheme of a serious polar sledge-journey far beyond its superior comfort as compared with a tent.

The igloo and suitable fur clothing permit discarding tent and accessories and sleeping-bags. These items are among the so-called "constants" of a sledge-load, that is, those items which remain the same throughout the journey as distinguished from the food, which is constantly diminishing.

As a matter of fact, tent and sleeping-bags do not remain a "constant" weight, but *increase* in weight with steadily accumulating frozen moisture. On the British North Pole Expedition of 1875–76 the weight of tent outfit for a sledge-party, and its increase in weight during the journey, are given as follows. ("Voyage to the Polar Sea," Nares, Vol. 1, page 172.):

	Before Starting	On Return
Tent	31 pounds 14 ounces	55 pounds
Sail	9 pounds 1 ounce	17 pounds
Coverlet	21 pounds 1 ounce	48 pounds
Lower robe	18 pounds 4 ounces	40 pounds
Floor cloth	11 pounds 4 ounces	29 pounds
Total	91 pounds 8 ounces	189 pounds

Sleeping-bags increased in weight from 8 pounds 2 ounces to 17 pounds. That, however, is somewhat beside the main point, which is this: The elimination of tent, accessories, and sleeping-bags means the ability to carry an additional amount of pemmican equal to the weight of tent and bags, and pounds of pemmican mean miles of travel. The definite and vital application is this: Shackleton in 1909 was obliged to stop when within ninety-seven miles of the south pole and return because his food was not sufficient to take him there and back to his ship.

Shackleton's tent and sleeping-bag outfit for his southern party of four men weighed, *when dry,* one hundred pounds.

Two tents, with poles and floor cloths, each weighing complete 30 lbs. Four sleeping bags, each weighing 10 lbs. when dry.—"The Heart of the Antarctic," Shackleton, Vol. I, p. 249.

If in place of his tent and bags he had had one hundred pounds of pemmican, he could have made the distance and could have won the pole.

One hundred pounds of pemmican represents twenty-five days' rations for four men.

During the winter of 1905–06, on board the *Roosevelt,* Marvin and I worked out very thoroughly, first with pencil and paper, and afterward graphically with the assistance of a long twelve-inch-wide board and a twelve-foot graduated measuring-rod, match-boxes for sledges, and per-

cussion caps, of which I had a large number, for rations, an arrangement for a continuous post-road transportation service, with snow igloo stations at convenient distances. This system, with my men and my equipment, could be kept in commission regardless of temperatures or the darkness of the winter night, barring only those occasional blizzards during which both man and beast must seek and remain in shelter.

By this arrangement an advance party could be pushed ahead, kept provisioned, and its communication with the rear kept intact during any season of the year and for any distance with the regularity of a Maine winter lumber-camp tote-road—granted a permanent surface.

I found that this method, attractive as it was, could not be utilized on the uncertain surface of the frozen north polar sea, and it was given up for that region.

It is entirely practicable in the antarctic region, where the surface is permanent and unchanging from year to year, and by utilizing it some future explorer of that region can travel at will as far as and in any direction he may desire.

In the active working out of a polar advance there are numbers of details of practical technic. If the line of march lies through deep, soft snow, an active man in the lead, with broad packers' snowshoes, can tread a trail that greatly reduces the labor of the following dogs. If there are two

men to put in advance, the road is still further improved. Such a road, once made by snowshoes and sledges, can be detected even in the darkness of the winter night by its distinctly firmer consistency.

Sledges should always travel in single file so as to utilize to the utmost the trail-breaking of each sledge. Of course the brunt of the work comes on the leading sledge. The next sledge finds it somewhat easier, the next easier yet, until the last sledge has a firmly beaten trail over which to travel. To equalize work, I had the leading sledge at the end of each hour drop back to the rear. In this way each driver and team of dogs had an equal share of the work.

Contrary to popular opinion, a trail across sea ice or inland ice made by the passage of a party of several sledges and teams of dogs can be recognized and followed by those who have the training and knowledge, weeks or even months afterward. A snow-storm does not obliterate a trail for any considerable consecutive distance. In these latitudes a fall of snow is usually soon followed by wind, and while this wind may drift and pack snow over one section of the trail a few hundred yards in length, in other places it will scour the snow away and leave the straight lines of the sledge-runners, the print of a man's moccasin, or the five-leaf clover-like impression of a dog's foot standing up in relief from the sur-

rounding surface. Every effort, however, was made in my work to strengthen the marking of the trail, and thus make it easier to follow on the return march, because retaining the trail was such a vital matter in the interests of speed and conservation of energy. Tins of pemmican emptied at each camp in feeding the dogs and members of the party—these tins being painted bright red or blue—were cut in half and left on a pinnacle of ice or sticking up in the trail every half-mile or so of the next march.

Tired dogs near the end of a march can be brightened up and enticed over the last mile or two if the leader of the party snow-shoeing in advance of the sledges, indulges in the Eskimo pantomime of sighting, following, and creeping up upon an imaginary seal, polar bear, or musk-oxen. In crossing comparatively narrow lanes of very thin young ice, where a driver was obliged to cross in another place than the sledge in order not to concentrate the weight too much, and where it was vital that the dogs should go across at full speed and not stop until the load was across, for if they did, the sledge would go through, I sent one man across in advance to a place fifty or a hundred feet on the firm ice beyond the other edge of the lead, and then in plain sight of the dogs he would stoop down and chop up an imaginary piece of walrus meat, at the same time giving the food-call to the dogs. As a result of this deception,

the dogs could hardly be restrained, and when at the proper moment they were allowed to start, nothing short of an earthquake could stop the team till it had reached the man on the other side. On one or two occasions the sledge partly breaking through before the other side was reached, was rushed out of the water and to safety by the dash and impetus of the dogs. This same method is also practicable in crossing the snow-bridges of the masked crevasses of the great ice of Greenland and the antarctic regions.

CONCLUSION

AT the request of friends I have turned away briefly from other work to take up the threads of the past and write this book.

That other work which has been demanding my attention has a very pronounced bearing on polar exploration, and in fact upon all exploration.

Five years ago at the annual dinner of the Explorers' Club I ventured the prophecy that in a few years the polar regions would be reconnoitered and explored through the air. The last three years of warfare abroad have forced the development of the aeroplane to such a degree that the time is now very near when aeroplanes will have such extended radius of certain flight as will make the preliminary reconnaissance of the unknown areas in the north and south polar regions a matter of a few weeks instead of several years.

The sheltered inlets of Bowdoin and McCormick Bays in Whale Sound, Greenland, are readily accessible every summer to a ship like the *Roosevelt* and an ice master like Bartlett. In these inlets during August there are days and days of brilliant, calm, warm weather, with temperature above the freezing point, and it is con-

tinuous daylight throughout the entire twenty-four hours all through the month.

Four hundred miles due north—four hours' aeroplane flight—is Cape Columbia, the most northerly point of the North American world segment, and less than 500 miles from the pole.

A squadron of aeroplanes starting from Bowdoin or McCormick Bays would reach Cape Columbia in a few hours with the whole panorama of Grant Land and the American gateway to the pole passing beneath, could alight on the firm level "glacial fringe" at Cape Columbia, unload their supplies and gasoline, and the supporting machines be back at their base in less than a day.

From Cape Columbia it is less than 1400 miles in a straight line directly across and over the pole to Cape Chelyuskin on the Siberian Coast, the most northern point of Eurasia. To Wrangel Island across Crocker Land and the entirely unexplored region between the pole and Bering Strait it is about 1500 miles.

From Cape Columbia to Spitzbergen, it is 900 miles, to Franz Josef Land less than 1000 miles, and to Point Barrow about 1400 miles.

The present average speed of aeroplanes is about 100 miles per hour. By the time this meets the reader's eye continuous flights of 1000 miles or more will be a matter of record. In the near future, continuous flights of 2000 miles will be made.

A squadron of aeroplanes with base at Cape Columbia, flying in pairs and making simultaneous trips could with good fortune make the reconnaissance indicated above in two weeks, then return to Bowdoin or McCormick Bays and take their ship home.

From the base in Bowdoin or McCormick Bays a week of successive flights northeast, east and southeast, would clear up all the interior features of the great island continent of Greenland.

In the South Polar regions with a base at McMurdo Sound in Ross Sea, south of New Zealand, —the favorite base of Scott and Shackleton,—a flight of 1800 miles across and over the South Pole would reach the known portion of Weddel Sea on the opposite side, and flights of 2000 miles would command the entire Antarctic continent.

In the very near future the biting air above both poles will be stirred by whirring aeroplane propellers, and when that time comes the inner polar regions will quickly yield their last secrets.

Looking forward to this certain materialization, it is a source of satisfaction that the two last great physical adventures, the winning of the North Pole and the South Pole,—the feats which clinched and made complete man's conquest of the globe,—were accomplished without the aid of such modern devices and inventions.

It seems entirely fitting that these tests of brute physical soundness and endurance which have en-

gaged the attention of the world for several centuries, should have been won by brute physical soundness and endurance, by the oldest and most perfect of all machines—the animal machine—man and the Eskimo dog.